Notes for Preparing the Technical Specifications

A set of precise and clear specifications is a prerequisite for Bidders to respond realistically and competitively to the requirements of the Procuring Entity without qualifying their bids. In the context of Competitive Bidding, the specifications (e.g. production/delivery schedule, manpower requirements, and after-sales service/parts) must be prepared to permit the widest possible competition and, at the same time, present a clear statement of the required standards of workmanship, materials, and performance of the goods and services to be procured. Only if this is done will the objectives of transparency, equity, efficiency, fairness and economy in procurement be realized, responsiveness of bids be ensured, and the subsequent task of bid evaluation and post-qualification facilitated. The specifications should require that all items, materials and accessories to be included or incorporated in the goods be new, unused, and of the most recent or current models, and that they include or incorporate all recent improvements in design and materials unless otherwise provided in the Contract.

Samples of specifications from previous similar procurements are useful in this respect. The use of metric units is encouraged. Depending on the complexity of the goods and the repetitiveness of the type of procurement, it may be advantageous to standardize the General Technical Specifications and incorporate them in a separate subsection. The General Technical Specifications should cover all classes of workmanship, materials, and equipment commonly involved in manufacturing similar goods. Deletions or addenda should then adapt the General Technical Specifications to the particular procurement.

Care must be taken in drafting specifications to ensure that they are not restrictive. In the specification of standards for equipment, materials, and workmanship, recognized Philippine and international standards should be used as much as possible. Where other particular standards are used, whether national standards or other standards, the specifications should state that equipment, materials, and workmanship that meet other authoritative standards, and which ensure at least a substantially equal quality than the standards mentioned, will also be acceptable. The following clause may be inserted in the Special Conditions of Contract or the Technical Specifications.

Sample Clause: Equivalency of Standards and Codes

Wherever reference is made in the Technical Specifications to specific standards and codes to be met by the goods and materials to be furnished or tested, the provisions of the latest edition or revision of the relevant standards and codes shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national or relate to a particular country or region, other authoritative standards that ensure substantial equivalence to the standards and codes specified will be acceptable.

Reference to brand name and catalogue number should be avoided as far as possible; where unavoidable they should always be followed by the words “or at least equivalent.” References to brand names cannot be used when the Funding Source is the GOP.

Where appropriate, drawings, including site plans as required, may be furnished by the Procuring Entity with the Bidding Documents. Similarly, the Supplier may be requested to provide drawings or samples either with its Bid or for prior review by the Procuring Entity during contract execution.

Bidders are also required, as part of the technical specifications, to complete their statement of compliance demonstrating how the items comply with the specification.

Technical Specifications

Item	Description	Statement of Compliance Bidders must state here either “Comply” or “Not Comply” against each of the individual parameters of each Specification stating the corresponding performance parameter of the equipment offered. Statements of “Comply” or “Not Comply” must be supported by evidence in a Bidders Bid and cross-referenced to that evidence. Evidence shall be in the form of manufacturer’s un-amended sales literature, unconditional statements of specification and compliance issued by the

		manufacturer, samples, independent test data etc., as appropriate. A statement that is not supported by evidence or is subsequently found to be contradicted by the evidence presented will render the Bid under evaluation liable for rejection. A statement either in the Bidders statement of compliance or the supporting evidence that is found to be false either during Bid evaluation, post-qualification or the execution of the Contract may be regarded as fraudulent and render the Bidder or supplier liable for prosecution subject to the provisions of ITB Clause 3.1(a)(ii) and/or
ITEM	**DESCRIPTION AND SPECIFICATION**	
	LOT 1- P 29,445,787.30 (Including Civil Works P 599,787.30.00)	
1.1	**Augmented Welding Training Laboratory**	
1	**Augmented Welding Trainer Simulator with Complete Accessories and Furniture**	
	Includes: **AUGMENTED WELDING SIMULATOR :** Supported welding processes: Manual arc welding, MIG/MAG, TIG, SMAW, GMAW, GTAW Supported joints: Standard version (T-Joint, Lap Joint, V-Butt Joint, Pipe V-Butt Joint, Pipe T-Joint) Welding positions: PA, PC/PG, PE, PH/PJ, H-L045/J-L045, PB, PD, 1F, 2F, 3F, 4F, 1G, 2G, 3G, 4G, 5G, 6G Workpieces positions: plain, vertical, flat, overhead Voltage selection: 10V-30V MIG/MAG (GMAW), FCAW 12V-32V Intensity (Ampearage0 selection: electrode (SMAW) 50A-240A MIG/MAG (GMAW), FCAW 25A-270A Polarity selection: DC+, DC-, AC Shielding gas selection (standard version): 2.50, 3.25 y 4.00 mm. Wire speed selection: MIG/MAG (GMAW), FCAW 1.2-20.0m/min. Base material selection(standard): carbon steel Electrode stick selection(main): base, rutile	
	Electrode stick diameter selection(standard): 2.50, 3.25 y 4.00mm.	
	Filler rod selection (standard version): 2.00 and 2.40 mm. Diagnostic and evaluation mode(standard): Basic diagnostic module Power supply: 115-230V, 5A-11A, 50-60 Hz Over power protection point at 110%-130% full oad Dimensions: 400x230x440 mm Weight: 15 kgs. Appox w/o accessories 30 kgs. w/ accessories Accessories included(standard): welding torches (SMAW, GMAW(FCAW) and GTAW), welding mask w/ augmented reality, 5 workpieces, GTAW filler rod, all necessary cables	
	Dimensions and weight for traspo: 600x800x600mm export box (HxBxt). Europalet Total height: 700mm, Total weight (approx.): 45 kgs. Security packaging, ANTI-SHOCK SYSTEM Processor: intel core i7 3770, 4 cores, 3.60 GHZ speed, cache 8MB Chipset: intel H61(B3) express chipset Graphic board: 1024 MB GDDRS Hard disc: solid state, 64GB SSDNow, SATA2 2.5” Display Size: 9.7” Display resolution: HD LCD 1024x768xGA Port for external display/projector: VGA Augmented reality video glasses power suppy: 5V Cameras resolution (x2): 752x480/60 fps Cameras power supply: 5V Operating temperature: 3o-45o/37.4F~113F Master software: minimum hard requirements: windows vista, 7, processor 32bits (x86) 2.2 GHz 3MB, graphic 215MB directX 9.0c compatible, NVidia GeForce GT440 or higher, ATI Radeon HD5000 or higher, HDD 250MB **SERVER (1)** SbyOS Operating System | Processor Intel i3 Core 2.4GHz 3MB RAM 2GB | 2 Ethernet ports | HDD 500GB	

ITEM	DESCRIPTION AND SPECIFICATION	
	MID TOWER DESKTOP – Personal Computer (2) Processor: Intel Core i3-3220 (3.3GHz 3MB L2 Cache 1333MHz FSB) 65w Chipset: Intel B75 Express Chipset Memory: 2x2GB DDR3 1333MHz up to 16GB max support on 4DIMMs slots Hard Disk: 500GB Sata up to 2TB maximum capacity Video Card: ADV Galaxy GeForce GT630 2GB 128 Bit DDR3 HDMI/DVI/VGA Optical Drive: 16x SuperMulti Drive Video: Integrated Intel HD Graphics Solution Audio: Embedded high-defination with 5.1-channel surround sound support	
	LAN: Gigabit Ethernet 10/100/1000 Expansion: PCI Express 2.0x16 slot	
	PCI Express 2.0x1 slot Parallel Port: with Parallel Port Keyboard and Mouse: USB Keyboard & USB Optical Mouse Speaker: Internal Speaker Operating System: FQC-05919 Win Professional 8 Win 32 Eng Intl 1 pk DSP OEI DVD UPS: APC BK650AS 650VA UPS Monitor: AOC E1621SWB 15.6" LED Monitor **WIFI ROUTER (1unit),** 300Mbps **MULTIMEDIA PROJECTOR (2 units)** USB 3LCD Projector, 2800 (or better)Lumens White and Colour Light Output , Computer Cable, USB A/USB B Cables, Remote Control, Soft Carry Case & Manual	
	FURNITURE: **1. Teacher's Table (2 units)** - Dimension: 1.5m Length x 0.50m Width x 0.76m Height Phenolic top: 0.25mm thickness. - Epoxy coated steel tubular base, brackets and frames with adjustable leveler 2. **Student Working Table (7 units**) - Dimension:1.5m Length x 0.50m Width x 0.76m Height - Phenolic top 0.25mm thickness. - Epoxy coated steel tubular base, brackets and frames with adjustable leveler **3. Executive Chair for teacher (2)** • Executive type • Non Folded • Finished Materials: PU + Steel + PP or equivalent • Back: PU or better • Seat: Cutting sponge with PU or better ; • Armrest: steel, powder coated or of similar quality • Foam: High Density Foam or better • Steel leg, powder coated steel structure • Color: preferably Navy blue 4. **Student Stools (20 pcs)-**Molded resin seat board, epoxy coated steel legs and frames with hard rubber footing. • 12" round wooden seat, at least 1" thick, • Tubular 4-legged base • 18" Seat Height **5. Stacking chairs for students (50 pcs)** • Chair seat & back: high-quality polypropylene, • Chair frame: Round steel tube (heavy duty) , high quality electro-static powder coated • Stacks 10 high from the floor • Color: Navy blue/ dark blue	
	6. Storage Cabinet (1) • HxLxW: 1.20m x 1.9m x 0.5m • Sliding Glass doors on powder-coated aluminum frame with lock • 18mm laminated boards with PVC edging or equivalent	
2	**Arc Welding Machine (200A)**	
	Specs: Welding Amperage: (High: 40-235A), (Low: 30-150 A) Max open circuit voltage: 80 Amps input at rated output 50 or 60 Hz, 1-phase, 230V: 47.5, 2.3 Dimensions(HxWxD): 476mmx323mmx445mm Accessories: - 3 m welding cable (38mm) - 1.5 m grounding cable - Jackson electrode holder 300A - ground clamp 300 amps	

ITEM	DESCRIPTION AND SPECIFICATION	
	- ground clamp 300 amps	
3	**Arc Welding Machine (300A)**	
	- input power: 230/400 VAC 3 phase - rate output: 320 A 35% duty cycle - output range: 50-320 A - max open-circuit voltage: 68 VDC	
	- dimensions: 980x410x650 mm - weight: 70kg.	
4	**MIG Welding Machine with Complete Accessories**	
	MIG welding machine 280A Primary Supply: 3 ph (415 V) Max input current: 24A Output rating: 280A/ 28V Duty cycle @ 100%: 190A/24V Output control: Tapping Open circuit voltage: 18-39V Welding range at 50-210A: 40-280A Filler wire size range: 0.6-1.2mm Wire feeding speed: 1-17m/min Time (Spot/Stitch): 0-5 sec Degree of protection: IPS21 Insulation class: H 180degree C Weight(w/o cable and plug): 125 kgs. Dimension (LxWxH): 950mmx510x838mm Contents: - 1 MIG Torch assembly - 5 pcs. MIG Nozzle - 10 pcs Contact Tip - 1 can MIG Nozzle cleaner - 1 spool MIG wire 0.8mm	
5	**TIG Welding Machine(300A) with Complete Accessories**	
	Specs: Input: 26 KVA (50/60hz)	
	DC output current: 5-300A AC output current: 20-300V DC output voltage: 16-20V (TIG), 20-32 (Manual) AC output voltage: 16-22V (TIG), 20-35V (Manual) Duty cycle: 100% @200 A(may vary accdg. To room temp.) Weight: 175 kgs - High frequency - TIG torch assembly - automatic darkening welding machine mask - argon gas with cylinder - argon regulator - 10 pcs tungsten 2.4mm - 5 pcs ceramic cup - 10 pcs collet - 10 pcs collet holder 5 kls filler rod 2.4mm	
6	**Oxygen-Acetylene Welding Cutting Outfit**	
	Specs: - oxygen cylinder with oxygen gas - acetylene cylinder with acy gas - twin hose 10 ft (3m) - 1 set oxy-acy regulator - 1 set flashback arrester	
7	**Industrial Cut-off Machine w/ Cutting Disc 14"**	
	Content: (Heavy Duty) - cutting disc, 14" (3 pcs)	
8	**Angle Grinder (2kW)**	
	Angel grinder 4" Deadman switch	

ITEM	DESCRIPTION AND SPECIFICATION	
	- cutting disc, 4" (10 pcs)	
9	**Complete Welding PPE (gloves, apron, mask)**	
	Specs: - welding mask (heavy duty) - faceshield visor (heavy duty) - welding apron (heavy duty)	
10	**Ground clamp (300 Amps)**	
11	**Electrode Holder (300 Amps)**	
Civil Works (Program of Works, Detailed Cost Estimates, Drawings, etc.		
12	Laboratory Repairs Renovation b. 1 for MUST Campus Lab b.2 for Jasaan Campus Lab *(pls see details in approved EDP)*	
Note: All packages should come with complete training program, laboratory manuals/workbooks *Training Details:* *Description* *No limit of the number of participants.* *Duration of training:* *a. Augmented Welding simulator: 5 days during the contract period.* *b. Actual Welding Machines: 2 days*		
LOT 3- 39,717,835.00 (Including Civil Works P 309,835.00)		
3.1 Eelctrical and Electronics Circuits Laboratory		
13	**Development Module with Power Supply**	
	POWER SUPPLY A- TECHNICAL DATA 1) Metallic box. 2) Fixed outputs: + 5 V, ± 12 V, 1 A. 3) Variable outputs: ± 12 V, 0.5 A. 4) AC output: 12V. or 24 V. 5) Outputs through either 2 mm. contact terminals, or through 25 pin CENTRONICS connectors (2 outputs). 6) LED's voltage indicators. 7) Robust construction. 8) Supply: 110/220V.A.C. 9) Frequency: 50/60 Hz. 10) Includes all the requirements for full working with any kit. 11) Dimensions: 225 x 205 x 100 mm. approx. Weight: 2 Kg. approx. DEVELOPMENT MODULE A- TECHNICAL DATA: 1) This is a module to build and implement student's own circuits, it consists on: - Development board. - Power supply connector. - Digital visual display unit - Logical source.	
	- Set of potentiometers. - Pulse generator and inverters. - Interrupter. - Clock. 2) Development Module 3) Dimensions: 300 x 210 x 45 mm. approx. Weight: 300 gr. approx.	
14	**Direct Current Circuits Kit**	
	A- TECHNICAL DATA: The purpose of Electronics and Electricity Assembly Kits is to provide the students with the necessary elements for creating their own circuits. 1) DC Circuits kit contains: - Assembly and practice manuals (1 manual supplied). - Set of components and wires necessary for mounting the corresponding practice. - After the first assembly, all the elements are recoverable. 2) KIT Contents : • Manuals.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Set of practice wires. • 1 switch, 2 positions. • 5 switches, 3 positions.	
	• 1 red lamp12V. • 1 button potentiometer 10K. • 1 button potentiometer 500 ohms. • 1 resistance 0 (bridge). • 2 resistances 1.5K • 1 resistance 100 ohms. • 5 resistances 10K • 1 resistance 12K. • 5 resistances 1K. • 5 resistances 2.2K. • 3 resistances 2.7K • 1 resistance 33 ohms. • 2 resistances 330 ohms. • 4 resistances 4.7K • 1 resistance 470K. • 2 resistances 680 ohms 3) Direct Current Assembly Kit: Dimensions: 300 x 300 x 200 mm. approx. • Measurement managing and checking instruments: • Electronic instrumentation operation. Use of multimeter. • Study of faults in the Resistance circuit. • Ohm's Law: • Ohm´s Law verification. • Power calculation • Resistors: characteristics and types: • Resistors measurement. Color code. Ohmmeter. • Study of Faults in Resistors circuit • Resistors association and the Wheatstone Bridge:	
	• Voltage and current measurement in a circuit with resistors connected in series. • Series/Parallel configuration study. • The Wheatstone Bridge. • Study of Fault in Series Resistors circuit. • Study of Fault in Parallel Resistors circuit. • Study of Fault in Wheatstone Bridge circuit. • Kirchoff's laws: • Kirchoff's first law. • Kirchoff's second law. • Fault study using Kirchoff's law.	
15	**Alternating Current Circuits Kit**	
	A- TECHNICAL DATA: The purpose of Electronics and Electricity Assembly Kits is to provide the students with the necessary elements for creating their own circuits. 1.Each kit contains: - Assembly and practice manuals (1 manual supplied) - Set of components and wires necessary for mounting the corresponding practice.	
	- After the first assembly, all the elements are recoverable. 2.AC Circuit Kit Contents : • Manuals. • Set of practice wires. • 3 coils 100 mH. • 4 coils 10 mH. • 3 coils 68 mH. • 1 ceramic capacitor 220 pF. • 1 ceramic capacitor 470 pF. • 3 capacitors POLY 100 nF. • 1 capacitor POLY 10 nF. • 1 capacitor POLY 1 nF. • 1 capacitor POLY 220 nF. • 2 capacitors POLY 22 nF. • 1 capacitor POLY 470 nF. • 1 capacitor POLY 47 nF.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• 1 variable capacitor 5.5 - 65 pF. • 9 switches, 2 positions. • 8 switches, 3 positions. • 1 resistance 10 ohms. • 3 resistances 100 ohms. • 1 resistance 100K. • 9 resistances 10K. • 13 resistances 1K. • 7 resistances 2.2K. • 1 resistance 270 ohms. • 1 resistance 3.3K. • 4 resistances 330 ohms. • 5 resistance 4.7K. • 3 resistances 470 ohms. • 4 resistances 680 ohms.	
	• 1 transformer 2.8 VA. • 1 red lamp 12V. direct current. • 1 button potentiometer 10K. • 1 button potentiometer 500 ohms. • 1 resistance 0 (bridge). • 2 resistances 1.5K. • 1 resistance 12K. • 3 resistances 2.7K. • 1 resistance 33 ohms. 3) Dimensions: 300 x 300 x 200 mm. approx. This kit is designed to be able to do the following practices: Alternating signal characteristics instruments: • Waveforms study in A.C. • Introduction of anomalies in the Wave form circuit. • Study of Faults in the Wave form circuit. • Relation between peak values and RMS for sinusoidal waves. • Resistance in a sinusoidal alternating current.	
	• Measurements using the oscilloscope. • Voltage and current phase angles for resistors in sinusoidal alternating current. • Sinusoidal A.C. resistors in series. • Sinusoidal A.C. resistors in parallel. Behaviour of A.C. capacitors and inductors: • Capacitance with square waveform and sinusoidal input current. • Inductance with square waveform and a sinusoidal input voltage. • Reactive reactance, Xc, variations with the frequency. • Study of faults in capacitors. • Reactive capacitance variations with capacitance. • A.C. capacitors in parallel. • A.C. capacitors in series. • A.C. capacitors as voltage dividers. • Inductance in an A.C circuit. • Inductive reactance variations with the inductance. • Inductors in series in an A.C. circuit. Basic theorems and capacitance and inductance circuits: • A.C. Resistor-Capacitor circuits in series. • A.C. Resistor-Capacitor circuits in parallel. • A.C. Resistor-Inductor circuits in series. • Study of Faults in the Circuit. • A.C. Resistor-Inductor circuits in parallel. RLC Circuits: • Resistance-Capacitance Filters. • Filters inductive resistance. Low-Pass and High-Pass filters. Resonance: • A.C. L-C Circuits in parallel with low impedance source. • Study of Faults in the resonance circuit. • A.C. L-C Circuits in parallel with high impedance source. • Circuit frequency response and bandwidth.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• A.C. R-L-C Circuits in series.	
	• Study of Faults in the resonance circuit. The transformer: • The transformer. • The transformer with load. Current measurement in the secondary transformer with charge.	
16	**Semiconductors I Kit**	
	A- TECHNICAL DATA: The purpose of Electronics and Electricity Assembly Kits is to provide the students with the necessary elements for creating their own circuits. Each kit contains: - Assembly and practice manuals (1 manual supplied).	
	- Set of components and wires necessary for mounting the corresponding practice. - After the first assembly, all the elements are recoverable. KIT Contents of the following: • Manuals. • Set of practice wires. • 3 ceramic capacitors 1µF. • 1 ceramic capacitor 100 pF. • 1 bypass ceramic capacitor 100 nF. • 3 capacitors ELCO. 100µF. • 5 switches, 2 positions. • 5 diodes. • 1 button potentiometer 10K. • 2 button potentiometers 1K. • 1 button potentiometer 5K • 1 resistance 1.5K. • 4 resistances 100 ohms. • 2 resistances 100K. • 8 resistances 10K. • 1 resistance 11K. • 2 resistances 12K. • 6 resistances 1K. • 1 resistance 1M. • 2 resistances 4.7K. • 3 resistances 47K. • 1 resistance 560 ohms. • 7 transistors. • 1 transistor BC557. • 2 transistors BF256A. Experiments Possibilities: This kit is designed to be able to do the following practices: Complementary transistors pair: Transistors pair with alternating signal Fault study of the complementary Transistor pair. Darlington configuration: Darlington configuration.	
	Fault study of the Darlington configuration. Differential amplifier: Differential amplifier. Fault study in the differential amplifier. Study and characteristics of the JFET transistor: JFET characteristics. Fault study with the JFET transistor Analog switch: Analog switch Multistage Amplifier. Direct coupling: Amplifier coupled directly.	
	Fault study of an amplifier coupled directly.	

ITEM	DESCRIPTION AND SPECIFICATION	
17	**Semiconductors II kit**	
	A- TECHNICAL DATA: The purpose of Electronics and Electricity Assembly Kits is to provide the students with the necessary elements for creating their own circuits. Kit Contents of the following : • Manuals. • Set of practice wires. • 3 ceramic capacitors 1µF. • 1 ceramic capacitor 100 pF. • 1 bypass ceramic capacitor 100 nF. • 3 capacitors ELCO. 100µF. • 5 switches, 2 positions. • 5 diodes. • 1 button potentiometer 10K. • 2 button potentiometers 1K. • 1 button potentiometer 5K. • 1 resistance 1.5K. • 4 resistances 100 ohms. • 2 resistances 100K. • 8 resistances 10K. • 1 resistance 11K. • 2 resistances 12K. • 6 resistances 1K. • 1 resistance 1M. • 2 resistances 4.7K. • 3 resistances 47K. • 1 resistance 560 ohms. • 7 transistors. • 1 transistor BC557. • 2 transistors BF256A. Dimensions : 300 x 300 x 200 mm. approx. EXPERIMENTS POSSIBILITIES: This kit is designed to be able to do the following practices: Complementary transistors pair. Transistors pair with alternating signal. Fault study of the complementary	
	Transistor pair. Darlington configuration: Fault study of the Darlington configuration. Differential amplifier: Fault study in the differential amplifier. Study and characteristics of the JFET transistor: JFET characteristics. Fault study with the JFET transistor. Analog switch: Multistage Amplifier. Direct coupling: Amplifier coupled directly.	
	Fault study of an amplifier coupled directly	
18	**Oscillators Kit**	
	TENDER SPECIFICATIONS A- TECHNICAL DATA: The purpose of Electronics and Electricity Assembly Kits is to provide the students with the necessary elements for creating their own circuits. Kit contents the following: • Manuals. • Set of practice wires. • 2 coils 10mH. • 1 coil 1mH 5MM. • 1 I.C. NE555. • 1 I.C. TL072. • 3 bypass ceramic capacitors 100 nF.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• 4 capacitors POLY 1µF. • 8 capacitors POLY 100 nF. • 5 capacitors POLY 10 nF. • 1 capacitor POLY 2.2 nF. • 2 capacitors POLY 4.7 nF. • 2 diodes. • 2 button potentiometers 1K. • 1 button potentiometer 500K. • 1 button potentiometer 5K. • 2 resistances 0. • 2 resistances 100K. • 4 resistances 10K. • 2 resistances 15K. • 2 resistances 1K. • 1 resistance 1M. • 6 resistances 2.2K. • 1 resistance 220K. • 2 resistances 22K. • 2 resistances 470 ohms. • 3 transistors Dimensions: 300 x 300 x 200 mm. approx. Experiment Possibilities: This kit is designed to be able to do the following practices: Oscillators.	
	RC and LC Nets:. RC net oscillator. LC net oscillator. Faults study with RC and LC Net oscillators. Wien bridge oscillator: Wien Bridge. Fault study in the Wien bridge oscillator. Colpitts oscillator. Hartley oscillator: Colpitts oscillator. Hartley oscillator.	
	Faults study with the Colpitts oscillator. Astable multivibrator: Astable multivibrator. Fault study with an Astable multivibrator. 555 TIMER: 555 timer. 555 timer fault study.	
19	**Operational Amplifiers kit**	
	TENDER SPECIFICATIONS A- TECHNICAL DATA: Each kit contains: - Assembly and practice manuals (1 manual supplied). - Set of components and wires necessary for mounting the corresponding practice. - After the first assembly, all the elements are recoverable. KIT contents of the following: • Manuals. • Set of practice wires. • 1 I.C. LM318. • 1 I.C. OP07. • 6 I.C. UA741 operational amplifier. • 16 bypass ceramic capacitors 100nF. • 6 switches, 2 positions. • 2 button potentiometers 100K. • 1 button potentiometer 50K. • 2 button potentiometers 5K. • 1 vertical multi-turn potentiometer 10K.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• 1 resistance 100 ohms. • 6 resistances 100K • 3 resistances 10K. • 2 resistances 15K. • 2 resistances 1K. • 2 resistances 200K. • 1 resistance 300K. • 3 resistances 30K. • 2 resistances 50K. Dimensions: 300 x 300 x 200 mm. approx. EXPERIMENTS POSSIBILITIES:	
	This kit is designed to be able to do the following practices: Operational amplifier characteristics: Operational amplifier study. Closed-loop output compensation voltage. Operational amplifier fault study. The inverting amplifier: Inverting amplifier study. Inverting amplifier fault study. The non-inverting amplifier:	
	Study of the non-inverting amplifier. Voltage follower. Fault study in the non- inverting amplifier. The adder amplifier: Adding amplifier study. Fault study in the adding amplifier. The differential amplifier: Differential amplifier study. Differential amplifier fault study. Comparators: Comparator study. Comparators fault study.	
20	**Filters kit**	
	TECHNICAL DATA: The purpose of Electronics and Electricity Assembly Kits is to provide the students with the necessary elements for creating their own circuits. KIT contents the following : • Manuals. • Set of practice wires. • 1 I.C. TL071. • 1 I.C. TL072. • 1 I.C. TL084. • 1 capacitor POLY 1µF. • 10 capacitors POLY 100nF. • 4 capacitors POLY 10nF. • 5 capacitors POLY 1nF. • 5 capacitors POLY 2.2nF. • 1 capacitor POLY 4.7nF. • 4 switches, 2 positions. • 4 diodes 1N4148. • 1 button potentiometer 1K. • 3 resistances 100K. • 9 resistances 10K. • 1 resistance 12K. • 9 resistances 15K. • 1 resistance 1K. • 1 resistance 1M. • 4 resistances 2.2K . • 1 resistance 2.7K. • 1 resistance 220K.	
	• 1 resistance 22K. • 4 resistances 27K.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• 13 resistances 3.3K. • 2 resistances 3.9K. • 3 resistances 4.7K. • 2 transistor. Dimensions : 300 x 300 x 200 mm approx. EXPERIMENTS POSSIBILITIES: This kit is designed to be able to do the following practices:	
	RC and LC filter responses: Frequency response. Low-pass filter High-pass filter. LC Circuit. Study of Error in Low-pass filter. Study of Error in High-pass filter. T-shaped Filter: Filter with double T link. Generator circuit of the signal S1. Study of Error in RC filter with double T. Active filters: Low-pass filter. Low-pass filter with load and operational amplifier. High-pass filter. High-pass filter with load and operational amplifier. The attenuattion is cumulative. Use of Operational Amplifier. Study of Faults in filter. Association of filters: Behaviour of the filter. Filter a distorted signal. Filter in cascade; low pass filter and high pass filter. Filter in parallel. Study of Error in filters.	
21	**Power Electronics kit**	
	A- TECHNICAL DATA: Each kit contains: - Assembly and practice manuals (1 manual supplied). - Set of components and wires necessary for mounting the corresponding practice. - After the first assembly, all the elements are recoverable. KIT contents the following : • Manuals. • Set of practice wires. • 1 I.C. 4N33. • 1 I.C. LM311. • 1 I.C. NE555. • 3 bypass ceramic capacitors 100nF 50V. • 2 multi-layer capacitors 1mF 25V.	
	• 3 switches 2 positions. • 2 DIAC. • 4 diodes 1N4001. • 1 diode 1N4148. • 4 diodes ZENER 15V. • 1 diode ZENER 8.2V. • 1 photo-resistance.	
	• 1 red lamp 12V. direct current. • 4 button potentiometers 100K. • 1 button potentiometer 10K. • 1 button potentiometer 5K • 2 resistances 1ohm. • 1 resistance 1.8K. • 2 resistances 100 ohms. • 1 resistance 100K. • 1 resistance 10K.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• 1 resistance 120 ohms. • 1 resistance 15K. • 6 resistances 1K. • 1 resistance 2.2K. • 1 resistance 220 ohms. • 3 resistances 390 ohms. • 3 resistances 4.7K. • 1 resistance 47ohms. • 2 thyristors. • 1 pulse transformer. • 1 transistor Bc327. • 1 MOSFET transistor. • 2 transistor. • 1 transistor VN10LM. • 2 TRIAC. Dimensions: 300 x 300 x 200 mm. approx. EXPERIMENTS POSSIBILITIES: This kit is designed to be able to do the following practices: The bipolar power transistor: Study of the power transistor. Study of faults in the power transistor. The MOSFET transistor: Study of the MOSFET transistor. Study of faults in the MOSFET transistor. The thyristor: Study of the thyristor Study of error of the thyristor. The UJT transistor and trigger circuits of the thyristor: Study of the trigger circuits of the thyristor. Study of insulation circuits. The TRIAC: Study of the TRIAC. Practical assembly of the TRIAC.	
22	**100 MHz Digital Oscilloscope**	
	Bandwidth: 100 Mhz 1GSa/s Sampling Rate 2 Channels 7” Widescreen LCD Color Display Equivalent Sampling Rate: 50GSa/S Memory Depth: Single Channel: 2 Mpts; Double Channels: 1 Mpts	
	Rise Time: <3.5ns Input Impedance: 1M ╟14pF Sec/Div range: 2.5ns/div-50s/div Scan: 100ms-50s/div Display: 7” LCD Color (480*234) USB Host/Device: Support USB Printer and USB Flash Drive PictBridge Function Easyscope Software	
23	**40 MHz Analogue Oscilloscope**	
	40MHz Dual Channel High Sensitivity 1Mv/DIV 5mV/div Sensitivity on Both Channels CH1 & CH2 Independent Channels CH1 Signal Output Unique Digital Filter function and Waveform recorder function Two waveforms in different frequency can be observed via alternative trigger function High-speed sweep Algebraic Addition and Subtraction X-Y Operation 0.2µs/div to 0.5s/div Time Base(Uncal up to 20ns)	

ITEM	DESCRIPTION AND SPECIFICATION	
	Z Modulation TTL Level 8 x 10 cm Display Internal Graticule TV signal synchronous function, TV Triggering Frame (V) & Line (H) Line Trigger ALT Triggering	
24	**DC Power Supply, 0-30V, 3A**	
	Technical Specification: AC Input Voltage: AC 220V±10%, 60Hz Rated Output Voltage: CH1 0~30V, CH2 0~30V, CH3 2.5V/3.3V/5V Rated Output Current: CH1 0-3A, CH2 0~3A, CH3- 3A Rated Output Power: 195W/315W Voltage Display Precision: 0.1V±2bit Current Display Precision: 0.01A±2bit Ripple and Noise: ≤ 1mVrms Voltage Stability: ≤0.01%+2mV Load Stability: ≤0.01% +5mV Protection Method: current-limited lower voltage protection Environment parameters: Relative humidity <80%, Temperature range 32- 104 F. (0-40	
25	**Function Generator, 5 Mhz**	
	Specification: Frequency Sine wave: 5MHz Square wave 0.1Hz ~ 2MHz (Valid Range) Triangle wave 0.1Hz ~ 1MHz (Valid Range)	
	Resolution 100mHz Frequency stability ± 1 ×10-6 Frequency error ±5×10-6 Square Wave Distortion <0.6% (Foundation frequency: 1kHz) Triangle Wave Linearity _98%,100mHz~100kHz; _95%,100kHz~1MHz Square Wave R ising & falling time <30ns TTL/CMOS Amplitude _3 Vp-p Fan Out 20TTL Load CMOS level 3.5~13.5 Vp-p Options Power Output Output Power _10W (4_Load) Output Wave: sine wave Frequency range: 20Hz~40kHz Counter Measure frequency range: 1Hz~40MHz Measure Voltage range _ 0.2V Error range: ±1×10-4 Others Supply voltage A C 2 2 0 V ±10%,50Hz ±5% (Line voltage setting is factory installed) Dimensions 265(W)×110(H)×300(D) Weight About 1.5kg	
26	**Spectrum Analyzer 1Ghz with Tracking Generator**	
	Specification: 150kHz to 1.05GHz (1050MHz) Dynamic Range 80dB (113dB with attenuation) AM & FM demodulator included 20 and 400 kHz resolution bandwidth 150kHz/hour stability Built-in tracking generator	
27	**Frequency Counter, 10Hz – 2700Mhz**	
	Features: 8-Digit LED display Few switches, for easy operation Quickness, high resolution Gate time: 0.01S/0.1S//1S Accuracy: ±1Hz, ±1 Count Figure, ±Time Base	

ITEM	DESCRIPTION AND SPECIFICATION	
	Accuracy:	
	Input Sensitivity:	
	10Hz~8MHz:75mV (Channel 1)	
	8MHz~10MHz: 30mV (Channel 1)	
	10MHz~100MHz: 30mV (Channel 1)	
	F1000C 100MHz~1000MHz: 30mV (Channel 2)	
	F2700C 100MHz~2400MHz: 30mV (Channel 2)	
	2.4Hz~2.7Hz: 30mV (Channel 2)	
	Input Impedance: 1M Ω at Channel 1, 50Ω at Channel 2	
	Max. Input Voltage: 250Vrms Channel 1, 5Vrms Channel 2	
	Max. Aging Rate: ±5ppm/year	
	Power Input: AC 220±10% (50/60Hz)	
	Power Consumption: approx. 5W	
	Dimension: 230(W) x 210(H) x 76 (D) mm	
	Weight: 1.8kg	
28	**Digital Multimeter**	
	3 1/2 LCD display with maximum reading of 1999	
	Overload protection	
	Auto power off function	
	Data hold function	
	Capacitance measurements	
	Shock Case	
	Mechanical protection	
	2000uF test function	
	Diode Testing : YES	
	Audio Testing : YES	
	Continuity Buzzer : YES	
	Auto power Off : YES	
	Data hold : YES	
	Low battery indication: YES	
	Technical Specification:	
	Voltage DC : 200mV/2V/20V/200V/1000V	
	Voltage AC: 200mV/2V/20V/200V/700V	
	Direct Current: 2mA/20 mA/200 mA/10A	
	Alternating Current: 2mA/20 mA/200 mA/10A	
	Resistance: 200Ω/2kΩ/20kΩ/200kΩ/2MΩ/20MΩ/200MΩ	
29	**Analog Multimeter**	
	Easy to assemble	
	-Break-proof body cover	
	-Solded test leads providing better safety	
	-Portable analog multitester	
	Technical Specification:	
	DCV: 0.3/3/12/30/120/300/600V (20k Ω/V)	
	ACV: 12/30/120/300/600V (9k Ω/V)	
	DCA: 60μ/3m/30m/0.3A	
	Resistance: 20/200/20k Ω	
	Battery check: 1.5	
	Bandwidth: 50 or 60Hz (sine wave)	
	Battery: UM-3(1.5V) x 2	
	Fuse: Ø5.2x20mm (250V/0.5A)	
	Size/Mass: H159.5 x W129 x D41.5mm/.320g	
	Standard Accessories included: Instruction Manual	
30	**RF Signal Generator**	
	Specifications:	
	Frequency range: (up to 450MHz on 3'th harmonics)	
	A: 100KHz ~ 320KHz.	
	B: 300KHz ~ 1,100KHz.	
	C: 1MHz ~ 3.3MHz.	
	D: 3.0MHz ~ 11MHz.	
	E: 10MHz ~ 35MHz.	

ITEM	DESCRIPTION AND SPECIFICATION	
	F: 32MHz ~ 150MHz. Frequency accuracy: ±5%.	
	RF output: 100mVrms, approx (up to 35MHz unloaded). Output control: HIGH-LOW switch and fine adjuster. Modulation: INT. 1KHz (AM) 30% approx. EXT. 50Hz ~ 20KHz, at less than 1Vrms input. Audio output: 1KHz, Min. 2 Vrms. Crystal oscillator: For 1 ~ 15MHz crystal in type HC-6u holder (not included). Power requirement: AC 115 / 230V, 50 / 60Hz Approx 3VA. Dimensions & weight: 150 (H) x 250 (W) x 130 (D) mm. Approx 2.5kgs. Accessories: BNC-clips x 1. Features: Wide frequency range: 100KHz ~ 150MHz. With 1KHz oscillator in inner part for the purpose of modulation. Of portable type, high stability.	
31	**Reworking & Soldering Station**	
	Technical Specifications: Input Voltage: 220V AC Power consumption: 550W(max) Air pump: Diaphragm Volume: 23L/min(max) Leakage voltage of Iron Tip: <0.5mV Temperature range of the nozzle: 100~480°C Temperature range of the iron tip: 200~480°C The standard iron tip: AT -900M Outer Dimensions:245×187×150 (L×W×H)mm	
32	**Soldering Iron & Station**	
	Specification: Power Consumption: 90W Input Voltage: 220VAC 50Hz or 110V 60Hz Output Voltage: 24VAC Temperature Range: 100 – 500°C （212 – 932°F） Temperature Calibration Range: -50 ~ +50°F (-58 ~ +122°F) Password Setting: 001 – 999 Automatic dormant temperature: 200°C Dormant setting: 1 – 99 min Temperature accuracy: ±10°C Temperature stability: ±2°C(static working mode) Tip to Ground Impedance: <= 2 Ohm Tip to Ground Voltage: <= 2 mV Size: 168(L) x 110(W) x 95(H) Weight: 2.5KG	
33	**Set of Tools (set of pliers, wire stripper, screw driver set.)**	
34	**Electronics Engineering Board,**	
	Features: compatible with NI-ELVIS	
	• 26 hands-on projects in Electronics Engineering • Menu-driven navigation through the labs • Student registration • Interactive representation of circuits in each hands-on project • Step-by-step instructions for students • Interactive study guide for each experiment • Preassembled board with 26 circuits • Representation of experimental results on the screen (graphs, scope signals, numeric indicators). Export of results in MS Excel format I. DC circuits 1. Voltage source in electric circuits 2. Light sensitive resistors (photoresistors)	

ITEM	DESCRIPTION AND SPECIFICATION	
	3. Kirchhoff's circuit laws 4. Electric power, performance factor, source and load matching 5. Ohm's law 6. Series connection of resistors 7. Parallel connection of resistors 8. Resistive voltage dividers 9. Temperature sensitive resistors (thermistors) 10. Voltage dependent resistors (varistors) 11. Charging and discharging of capacitors II. AC circuits 1. Parallel connection of capacitors 2. Series connection of capacitors 3. AC circuits with capacitors. Voltage, current and reactive impedance. Reactive power 4. Parallel connection of inductors 5. Series connection of inductors 6. Voltage and current over inductors. Reactive impedance. Reactive power 7. Series connection of a resistor and an inductor 8. Series connection of a resistor and a capacitor 9. Parameters of AC voltage and current. Active power 10. Operation of transformers in open-circuit mode 11. Operation of transformers in short circuit mode 12. Operation of transformers with resistive load 13. Transitory processes in RC networks 14. Transitory processes in RL networks 15. Transitory processes in RLC networks	
35	**Power Electronics Board**	
	Features • 17 experiments in Power Electronics • Menu-driven navigation through the labs • Student registration • Step-by-step instructions for students	
	• Interactive study guide for each experiment • Graphical representation of experimental results • Export of results in MS Excel format List of labs	
	1. Operational characteristics of DC voltage generators 2. Operational characteristics of AC voltage generators 3. Operational characteristics of DC current generators 4. Operational characteristics of linear voltage regulators (current instability) 5. Operational characteristics of linear voltage regulators (voltage instability) 6. Operational characteristics of switching voltage regulators 7. Operational characteristics of switching voltage regulators with filter 8. Operational characteristics of SCRs 9. Operational characteristics of Zener diodes 10. Operational characteristics of single-phase transformers in idle running and short-circuit modes 11. Operational characteristics of single-phase transformers with active loads 12. Operational characteristics of single-phase rectifiers without a filter 13. Operational characteristics of single-phase rectifiers with a filter 14. Characteristics of three-phase networks and transformers (star/delta connection) 15. Characteristics of three-phase networks and transformers (star/star connection) 16. Operational characteristics of single-phase controlled rectifiers with active load 17. Operational characteristics of three-phase controlled rectifiers with active load	
36	**Desktop Computer, all in one model**	
	Desktop Computer, all-in-one, 21.5 " LED monitor(or higher), CPU: I3; RAM: 4G; HDD: 1T; DVD RW; OS: Windows 8; mouse & keyboard; with UPS	
37	**(Laboratory Tables, Teacher & Student Chairs, Hanging storage Cabinet, Interactive Whiteboard & Multimedia projector)**	
	Laboratory Table (4 pcs) 2440 x 800mm, 30mm laminated board table top, with PVC edging.	

ITEM	DESCRIPTION AND SPECIFICATION	
	18mm laminated board with PVC edging, electrical outlets with removable front plate. Includes wiring provisions for four 2-gang universal outlet. Powder-coated Tubular steel metal framing. Detachable with joining pins. **Teacher's table (1)** 1000x950x780mm Table 18mm Laminated Board with PVC edging **Teacher's chair (1)** Executive type	
	Non Folded Finished Materials: PU + Steel + PP Back: PU or better Seat: Cutting sponge with PU or better ; Armrest: steel, powder coated or of similar quality Foam: High Density Foam or better	
	Steel leg, powder coated steel structure Color: preferably Navy blue **Laboratory Bench Stools (40 pcs)** 12" round wooden seat, at least 1" thick Tubular 4-legged base Steel tubing heavy duty frame 18" Seat Height Powder-coated frame Color: preferably Navy blue/ dark blue **Storage Cabinet (2pcs)** 1.20m x 1.90m Sliding Glass doors on powdercoated aluminum frame with lock 18mm laminated boards with PVC edging **Interactive Whiteboard (1)** 78" diagonal surface, 4 pens, 1wand, wall-mount, USB Interface computer connection, Workspace software; Infrared Technology-pen & finger touch with Windows, Mac or Linux; Multi-touch with Windows 7; aspect ratio; 4:3; 8000x8000 resolution; Android & IOS tablet compatible. **Multimedia Projector (1)** USB 3LCD Projector, 2800 (or better)Lumens White and Colour Light Output , Computer Cable, USB A/USB B Cables, Remote Control, Soft Carry Case & Manual	
3.2 Communications and Digital Laboratory		
38	**Educational Laboratory Virtual Instrumentation Suite**	
	Platform Features: • Open architecture for third-party plug-in boards • Hi-Speed USB plug-and-play connectivity • 1.25 MS/s oscilloscope • 51/2-digit isolated digital multimeter • ±15 and +5 V power supply • Manual control – function generator and variable power supply • Circuit protection with resettable fuse. Integrated Suite of 12 Virtual Instruments • Oscilloscope • Function generator (manual control) • Digital Multimeter (DMM) • Arbitrary waveform generator • Bode analyzer • 2-wire current voltage analyzer • 3-wire current voltage analyzer • Dynamic signal analyzer (DSA)	
	• Impedance analyzer • Digital reader • Digital writer • Variable power supply (manual control)	
	Driver Software (included) • NI-ELVISmx • LabVIEW SignalExpress	
39	**Fiber Optics Communication Board**	
	Compatible with ELVIS platform Specifications: - 20 patching leads - 7 optical fibers - headphones - user and experimenter manuals - BNC copes leads	

ITEM	DESCRIPTION AND SPECIFICATION	
	- easy to use and highly student resistant - allows the student to do over 12 experiments in digital and fiber optic communications in the one, - self contained portable unit - only requires the additional use of a PC - topics covered in Experiment Manual - introduction to the experimental module - PCM encoding - PCM decoding - Sampling and Nyquist in PCM - Time Division multiplexing (TDM) - Line coding and bit-clock regeneration - Fiber optic transmission - PCM-TDM 'T1' implementation - Optical digital filtering, splitting and combining - Fiber optic bi-directional communication - Wave division multiplexing (WDM) - Optical losses	
40	**Signal Processing Experimenter**	
	Compatible with ELVIS platform Includes: - 16 experiment Lab Manual covers - easily be integrated or adapted to suit your current signals and systems courses and text books Lab 1: Introduction to the SIGEx board Lab 2: Special signals – characteristics and applications Lab 3: Systems: Linear and non-linear Lab 4: Unraveling convolution Lab 5: Integration, convolution, correlation & matched filters Lab 6: Exploring complex numbers and exponentials Lab 7: Build a Fourier series analyzer Lab 8: Spectrum analysis of various signals Lab 9: Time domain analysis of RC networks Lab 10: Poles and zeros in Laplace domain Lab 11: Sampling and Aliasing Lab 12: Getting started with analog-to-digital conversion Lab 13: Discrete-time filters – FIR Lab 14: Poles and zeros in the z-plane: IIR forms	
	Lab 15: Discrete-time filters – practical applications App A: SIGEx Lab to Textbook chapter table SIGEx	
41	**Telecommunication Board**	
	Compatible with ELVIS platform - Board accessories kit includes: - 20 x stackable patch cords - User Manual	
	- Digital and Analog Basic Telecommunications Experiments Manual Volume-1 - DATEX SFP CD-ROM Telecommunication Topics: Basic Analog Communications AM, FM, DSB, SSB, PM, PAM, TDM, PWM, Superheterodyne, Speech in Comms, PLL, QAM, SNR Concepts and more Digital Communications PCM, PCM-TDM, ASK, BPSK, FSK, GFSK, Eye Patterns, DPSK, QPSK, Spread Spectrum, Line Coding, Noise Generation, SNR Concepts and more.	
42	**Digital Trainer**	
	Components: -standard PB-501 breadboard -8 Data Switches - The data switch circuits provides eight DATA OUTPUT pins D1 to D8 whose output level is adjusted using slide switches. • 8 Data Status Monitor - Has eight buffered inputs with LED indicators that show the current state of the inputs. • 555-Based Clock Generator - The circuit is based on a 555 IC configured as an astable multivibrator. The signal is accessible through the OUT pin. An overlapping LOW (10 Hz to 500 Hz) and control as well as VR1 for fine tuning control. • Pulse Generator - A monostable signal generator based on the 74HC221 IC. These are two outputs, pressing a switch generates a pulse across the corresponding output pin. • Logic Probe - The probe displays the status of the signal fed across its input pins using three LED status indicators, one each for HIGH, LOW and PULSE. • 5-Volt Power Supply - This supply is the same power source used for the rest of the modules such that the user need not worry about compatibility problems when using the built-in modules in the trainer.	
43	**Transmission Line Trainer**	
	All elements are mounted in a metallic box, with power supply and block diagrams. • Generator blocks: Square signal generator.	

ITEM	DESCRIPTION AND SPECIFICATION	
	Sine signal generator. Triangle signal generator. Each generator block has a Radio-Frequency Tuning and four BNC connectors with different line impedances (25 Ω, 50Ω, 75Ω and 100Ω). • Transmission line block:	
	Two transmission lines made of 40 m. length coaxial cable (total length joining the two transmission lines is 80 m.). Different test points along the lines (each 10 m.). • Load block: Fully configurable termination load, through switches on each load branch. Short circuit termination. Capacitive load. Resistive load (fixed electric resistances and potentiometers). Inductive load. Cables and Accessories, for normal operation.	
	• Manuals: Required Services Assembly and Installation Starting-up Safety, Maintenance & Practices Manuals. • Dimensions: 490 x 330 x 310 mm. approx. (19.29 x 12.99 x 12.20 inches approx.) • Weight: 20 Kg. approx. (44 pounds approx.).	
44	**Antenna Trainer**	
	Includes: • Control Interface Box: - Radio-Frequency generator - Spectrum analyzer - Stepper motor controller • Low power for safety operation (under 10dBm transmission power). • Radio-Frequency tuning, computer controlled. • Frequency control and measurement from the computer (PC). • Wide range of frequencies in UHF band. • BNC connector to transmitter antenna. • Operate in UHF band. • BNC connector to receptor antenna. • SWR- meter (included in the Control Interface Box): • Measurement of SWR from the computer (PC). • BNC connector to transmitter antenna. • BNC connector to radio-frequency generator. • Two towers antennas: • Tower for the receptor antenna. • Tower for the transmitter antenna. • Stepper motor coordinate with an encoder, all of these components are computer controlled. • allows the full-automatic 360° rotation of the transmitter antenna • EANC-1. Antennas Kit: • High sensibility Log-periodic antenna for the receptor.	
	• Monopole antenna with Ground plane. • Drooping monopole antenna. • Straight dipole antennas (λ/2 and λ). • Folded dipole antenna (λ/2). • Helical antenna (right-hand circular polarization). • Helical antenna (left-hand circular polarization). • Circular loop antenna. • Square loop antenna. • Diamond loop antenna. • Microstrip patch antenna. • Yagi-Uda antenna. • Antenna expositor • RF transformer • Space required between antennas: 2-3 m. Complete unit includes as well: • Advanced Real-Time SCADA. • Open Control + Multicontrol + Real-Time Control. • Specialized Control Software based on Labview. • National Instruments Data Acquisition board (250 KS/s , kilo samples per second).	
	• Projector and/or electronic whiteboard compatibility	
45	**Microwave Trainer**	
	Specifications: • Microwaves signal generator: o Solid state dielectric resonance oscillator (DRO). o Radio-Frequency tuning. o X-band range of frequencies from 8.8GHz to 12GHz. • Power meter.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• SWR meter. • Crystal probe. • Thermistor probe. • Slotted line waveguide. • Slide-Screw Tuner. • Crossguide waveguide. • Directional coupler. • MagicorHybrid Tee. • Variable attenuators waveguides. • Fixed attenuators waveguides. • Short circuit terminations. • Adjustable termination. • Dummy loads. • Two towers antennas, one of them with azimuth indicator. • Horn Antennas. • All the waveguide have the standard size WR90. • Cables and accessories, for normal operation. Exercise and practical possibilities: 1. Familiarization with a microwaves test bench. 2. Power emissions measurement. 3. Study of different Attenuation measurement.	
	4. Wavelength and frequency measurement through a probe mounted on a slotted line waveguide. 5. Wavelength and frequency measurement through a frequency meter. 6. Stationary wave (SWR) measurements. 7. Basic principles of Smith chart. 8. Impedance and admittance. 9. Complex impedance, reflection coefficient. 10. Stationary wave diagram for different loads. 11. Comparison of matched and mismatched loads. 12. Study of the Tees and crossguide. 13. Measure of wavelength in free space. 14. Measure of power emission in free space. 15. Study of gain and directivity of a horn antenna (dBi). 16. Radiation pattern of a horn antenna. 17. Reflection of a dielectric plate and metallic plate. Dimensions&Weight • Dimensions: 700x700x1100mm. approx. • Weight: 25 Kg. approx. Required Services • Electrical supply: single-phase, 220V./50Hz	
46	**Milliampmeter**	
	•Bright large screen VFD display •Digital display : 4 1/2 digits •Frequency range 5 Hz to 5 MHz •AC voltage 50 µV to 300 V •ACV test resolution is up to 0.1µV •Two independent input channels •Auto or manual ranging can be selected •Standard accessory interface is RS-232	
47	**Digital Multitesters**	
	• 3 1/2 LCD display with maximum reading of 1999 • Overload protection • Auto power off function • Data hold function • Capacitance measurements • Shock Case • Mechanical protection • 2000uF test function • Diode Testing : YES • Audio Testing : YES • Continuity Buzzer : YES • Auto power Off : YES • Data hold : YES • Low battery indication: YES Technical Specification: • Voltage DC : 200mV/2V/20V/200V/1000V • Voltage AC: 200mV/2V/20V/200V/700V • Direct Current: 2mA/20 mA/200 mA/10A • Alternating Current: 2mA/20 mA/200 mA/10A • Resistance: 200Ω/2kΩ/20kΩ/200kΩ/2MΩ/20MΩ/200MΩ	
48	**(Laboratory Tables, Interactive Whiteboard, Storage Cabinets & Multimedia Devices) 1 Lot**	
	LABORATORY TABLE (8pcs) 2440 x 800mm, 30mm laminated board table top with PVC edging, provided with grommet caps for computer monitor wire access.	

ITEM	DESCRIPTION AND SPECIFICATION	
	Powder-coated steel casing for table top electrical outlets with removable front plate, powder-coat finish. Includes wiring provisions for eight 2 gang universal outlet and LAN provision for two (2) computers. Plastic keyboard tray Powder-coated Tubular metal framing with perforated plate cover for table legs support and adjustable metal glides. 18mm laminated board with PVC Edgeband CPU shelving **MULTIMEDIA PROJECTOR (1)** USB 3LCD Projector, 2800 (or better)Lumens White and Colour Light Output , Computer Cable, USB A/USB B Cables, Remote Control, Soft Carry Case & Manual **INTERACTIVE WHITEBOARD (1)** 78" diagonal surface, 4 pens, 1wand, wall-mount, USB Interface computer connection, Workspace software; Infrared Technology-pen & finger touch with Windows, Mac or Linux; Multi-touch with Windows 7; aspect ratio; 4:3; 8000x8000 resolution; Android & IOS tablet compatible. **STORAGE CABINET (1)** 1.20m x 1.90m Sliding Glass doors on powder-coated aluminum frame with lock	
	18mm laminated boards with PVC edging	
3.3 Electrical Machines, Installation and Motor Controls		
49	**Analog Multimeter**	
	Easy to assemble -Break-proof body cover -Solded test leads providing better safety -Portable analog multitester Technical Specification: • DCV: 0.3/3/12/30/120/300/600V (20k Ω/V) • ACV: 12/30/120/300/600V (9k Ω/V) • DCA: 60μ/3m/30m/0.3A • Resistance: 20/200/20k Ω • Battery check: 1.5 • Bandwidth: 50 or 60Hz (sine wave) • Battery: UM-3(1.5V) x 2 • Fuse: Ø5.2x20mm (250V/0.5A) • Size/Mass: H159.5 x W129 x D41.5mm/.320g • Standard Accessories included: Instruction Manual	
50	**Digital Multimeter**	
	• 3 1/2 LCD display with maximum reading of 1999 • Overload protection	
	• Auto power off function • Data hold function • Capacitance measurements • Shock Case • Mechanical protection • 2000uF test function • Diode Testing : YES • Audio Testing : YES • Continuity Buzzer : YES • Auto power Off : YES • Data hold : YES • Low battery indication: YES Technical Specification: • Voltage DC : 200mV/2V/20V/200V/1000V • Voltage AC: 200mV/2V/20V/200V/700V • Direct Current: 2mA/20 mA/200 mA/10A • Alternating Current: 2mA/20 mA/200 mA/10A • Resistance: 200Ω/2kΩ/20kΩ/200kΩ/2MΩ/20MΩ/200MΩ	
51	**Integrated Laboratory for Electrical Machines**	
	A. Consisting of the following: **1. Electrical Machines Unit (Power Supply)** - Metallic box. - Diagram in the front panel. - Thermal Magnetic Circuit Breaker. - Two double switches (1 NO + 1 NC in each one) - Push Button (1 NC + 1 NO). - Three contactors with 2 NO and 1 NC.	
	- DC supply 200 V dc with fuses. - Connection Key - Emergency stop Push button. **2. Electric Power Data Acquisition System** A.1)Hardware : A.1.1.1) EPIB. Electric power interface box (dimensions: 300 x 120 x 180 mm. approx.):	

ITEM	DESCRIPTION AND SPECIFICATION	
	Interface that carries out the conditioning of the diverse signals that can be acquired in a process, for their later treatment and visualisation. Front panel separated in two: left-hand part for VOLTAGE sensors, and right-hand part for CURRENT sensors. - 8 analog input channels. - Sampling range: 250 KSPS (Kilo samples per second). - 4 Tension sensors AC/DC, 400V. - 4 Current sensors. A.1.1.2) DAB. Data acquisition board : PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI. Analog input: - Number of channels= 16 single-ended or 8 differential. - Resolution=16 bits, 1 in 65536. - Sampling rate up to: 250 KSPS (Kilo samples per second). - Input range (V)=± 10V. - Data transfers=DMA, interrupts, programmed I/0. Number of DMA channels=6. Analog output:	
	- Number of channels=2. Resolution=16 bits, 1 in 65536. - Maximum output rate up to: 833 KSPS. - Output range(V)=± 10. - Data transfers=DMA, interrupts, programmed I/0 Digital Input/Output: - Number of channels=24 inputs/outputs. - D0 or DI Sample Clock frequency: 0 to 1 MHz. - Timing: Counter/timers=2. Resolution: Counter/timers: 32 bits. A.2) Data Acquisition Software : - Data Acquisition Software with Graphic Representation: Amicable graphical frame. - Compatible with actual Windows operating systems. - Configurable Software allowing the Representation of temporal evolution of different signals. Visualization of Circuit tensions on the computer screen. - Sampling rate up to 250 KS/s (Kilo samples per second) guaranteed. **3. Three Phase transformer** - input and output connectors. - Three phase transformer, 400 V a.c - 230 V a.c., 1000 VA. - input and output connectors. **4. Single phase transformer,** 400 V a.c. - 230 V a.c., 400 VA. - Ground connector. **5. Variable autotransformer** - input and output connectors. - Three phase transformer, 400 V a.c - 230 V a.c., 1000 VA. - input and output connectors. **6. Resistive, Inducive and Capacitance Load Module** - Metallic box.	
	- Diagram in the front panel. - Variable resistive loads: 3 x [150(500 W) - Fixed resistive loads: 3 x [150(500 W) + 150 (500 W)]. - Inductive loads: 3 x [0, 33, 78, 140, 193, 236 mH].(230V /2 A) - Capacitive loads: 3 x [4 x 7 µF]. (400V) **7. DC Series Excitation Motor Generator** Power: 250-300W. Speed: 3000 r.p.m. V.excitation: 220 V.D.C. I.Excitation nominal: 0.3A. V.Armature.: 200V D.C. I.Armature nominal: 1.5A. **8. DC Shunt Excitation Motor generator** Power: 250-300W. Speed: 3000 r.p.m. V.excitation: 190 V.D.C. I.Excitation nominal: 0.3A. V.Armature.: 200V D.C. I.Armature nominal: 1.5A. **9. AC Synchronous Alternator Motor**	
	Power: 250-300W. Speed: 3000 r.p.m. Frequency: 50Hz. Connections: Star/triangle. V.excitation nominal: 220V D.C. I.Excitation nominal: 0.59A. V.Armature.: 3x220/380V. **10. Three Phase Asynchronous Motor Squirrel Cage (750rpm,8poles,550w)** Power: 250-300W. Speed: 2769 r.p.m. (50Hz), 3330 r.p.m. (60Hz). Connections: Star/triangle. Frequency: 50/60 Hz.	

ITEM	DESCRIPTION AND SPECIFICATION	
	V.Armature:230/400V (50Hz), 250/440V. (60Hz). I.Armature nominal: 1A-0.7A. **11. Three Phase Reluctance Motor** Three-phase. 380 V. Power: 200W. Speed: 3000 r.p.m. Frequency: 50 Hz. **12. Three Phase Asynchronous Motor with wound Rotor** Power: 300W. Speed: 1413 r.p.m. Frequency: 50Hz. V.Armature.: 230/400V. I.Armature nominal: 1A-0.7A. **13. Single Phase Asynchronous Motor with Starting Capacitor** Power: 370W. Speed: 2800 r.p.m. Frequency: 50Hz. V.Armature.: 230V. I.Armature nominal: 1.5A. **14. Single Phase Universal Motor** Power: 4-8W. Speed: 480/14000 r.p.m. Frequency: 50Hz. V.Armature.: 230/240V. Power: 250W. Speed: 2800 r.p.m. Frequency: 50 Hz. V.Armature: 230V. **15. Single Phase Asynchronous Motor with Starting and Running Capacitor** Power: 370W. Speed: 2800 r.p.m. Frequency: 50Hz. V.Armature.: 230V. I.Armature nominal: 1.5A. **16. DC Motor Speed Controller** - Metallic box. - Regulated voltage output up to 320 Vdc. Maximum current output 2 A. - Front panel including: Connections: - Positive, negative and Ground connections. on/OFF switch. - The top side of the unit include a wheel to adjust the DC output voltage up to 320 Vdc.	
	17. AC Motor Speed Controller - Metallic box. - Output: 3 PH, 3.0 KVA, 220 V, 1-50 Hz., 8.0 A. - Overload current Thermal protection. - on/OFF switch. - It has two blocks in the front panel: - Speed control: - Start/stop switch. - Speed control potenciometer. - Connections to motor: - Three-phase Connection to AC motor. - Ground connection. **B.Personal Computers (2 units)** Desktop Computer, all-in-one, 21.5 " LED monitor(or higher), CPU: I3; RAM: 4G; HDD: 1T; DVD RW; OS: Windows 8; mouse & keyboard; with UPS	
52	**Disassembly Machine Kit:**	
	Disassembly Machines Kit allows the student to construct, operate and make more than 50 assemblies and practices of different electrical machines. Specifications: base plate frame ring fixed and removable bearing housings shaft, squirrel cage rotor wound stator couplings armature poles and hub brushes brush holders commutator/slip rings interpoles armature field and interpole coils	
	compound field coils field coils centrifugal switch robust case for the elements necessary tools and elements for norml working operation	

ITEM	DESCRIPTION AND SPECIFICATION	
	all machies that may be assembled used low voltage, protected rotating part, operating at low power levels, - Panel for connections and protections: - Anodized aluminium structure with Panel in painted steel. - Diagrams for each practice, which explains the different connection configurations. - connections box, that allows to make different connections for each practice. - Protection circuit that is used to protect each module short circuits. - Drive motor: Asynchronous Three-phase motor of squirrel cage: Power: 370W. Speed: 2730 r.p.m. Frequency: 50/60 Hz. V.Armature:230/400V. I.Armature nominal: 1.67/0.97A. Connections: Star/triangle. - AC motor speed controller. Metallic box.	
	Power: 3kVA. Frequency: 1-50 Hz. Phase voltage: 230 Vac. Maximum current: 8A. Overcurrent thermal protection. ON/OFF switch. It has two blocks in the front panel: Speed control: Start/Stop switch and speed control potenciometer. Connections to motor: Three-phase connection to AC motor and ground connection. - DC motor speed Controller Metallic box. Adjustable voltage: up to 320 Vdc. Maximum current: 2 A. At the top of the unit there is a knob to adjust the DC voltage. Front panel including: Positive, negative and ground connections. ON/OFF switch. **- Velocity Control for stepper motor:** This unit is used for controlling the stepper motor assembly. Metallic box. Cables and accessories, for normal operation.	
53	**Integrated Electrical Installation Laboratory a. Modular Trainer (AC Motors) b. Modular Trainer for Electronics (Complete Option) c. Star Delta Starter**	
	a. Modular Trainer (AC Motors) Industrial Main Power Supply - Magneto-thermal protection. - Differential protection. - Double plug and terminals (three phase+singlephase).	
	- 2 lamps. - 8 terminals. - Mushroom security button. - Removable key. AC Auxiliary Power Supply (24Vac) - 230 / 24 Vac transformer. - 4 terminals. 3 Double Chamber Push-buttons. (2 units) - 3 d o uble chamber push buttons (one closed and one open) - for actions of start/stop of motors. 3-pole Contactor (24Vac) (4 units) - 3 pole contactor, 9 A. - Control coil 24 Vac. - Auxiliary contacts 3NO + 2NC. Frequency variator - Frequency, voltage and currect control and programming. - motor specification required for programming. Thermal relay (GV protector) module (2 units)	
	- Three-phase of 10A. Synchronization Relay (variable delay) - 2 regulation relays. - Work and rest activation time control. - Digital display. - Adjustable delay. Motor (squirrel cage)	

ITEM	DESCRIPTION AND SPECIFICATION	
	-squirrel cage. -Three phase Asynchronous motor. -270 W. -3000 rpm. Motor (Dahlander motor) -2 speeds. -Three phase Asynchronous motor. -250 W. -2800/1400 rpm. **b. Modular Trainer for Electronics** - AC and DC Power supply module that allows the following output voltages: Alternating: 15 + 25 V, 0.5 A 24 V, 2 A Direct: 24 V, 2 A 0-20 V, 2 A Inductances Module - 9 inductances from 1 mH to 45 mH for assemblies in alternating of R, L, C components Capacitors Module - 7 independent not polarised ones, from 56 nF 470 nF.	
	- 2 polarised of 220 mF and 470 mF V. Rectifier Diodes Module - Rectifier diodes of 40 A (6 units). - Some assemblies: Positive/negative simple rectification. Single-phase and three-phase bridge rectification. Double rectification. Filtrate of voltage of the assembies can be made Resistive Components Module - Fixed resistances, with values from 47 to 159 K ohms. (14 units). - Linear potentiometers , one of them coiled of 5 W. - Logarithmic potentiometers.(2 units). Three Phase Transformer - Transformer of three branches: Primary ones: 220 and 380 V. Secondary ones: 3x73 V by branch. Power: 500 W. - Possible practices: The transformer as a booster (single-phase). The transformer as a reducer Autotransformer Star connection (three-phase). Delta connection Transformers in series and in parallel (single-phase).	
	Electromagnetism Kits with group of motor/generator - It is based on A printed circuit with the components that can be easily seen. - Set of two coils. - Longitudinal magnet. - Group motor/generator with its axis united Dismantled transformer kit - A nucleus in "U". - A coil with 1000 turns. - A coil with 2000 turns. - Nucleus close in "I". - Case. Electrostatic kit - Ebinita bar. - Plexiglas bar. - Vertical base and hook. - Balls. - Cat skin. - Case for the components storage. - Acetate sheets. - aluminium sheets. - Electrometer Open Universal Motor - Universal motor open by its sides to see inside, specially the brushes. **c. Star-Delta Starter** Industrial Main Power Supply - Magneto-thermal protection. - Differential protection. - Double plug and terminals (three phase+singlephase). - 2 lamps. - 8 terminals. - Mushroom security button.	
	- Removable key.	

ITEM	DESCRIPTION AND SPECIFICATION	
	Push-Buttons with Light (24Vac) -3 push buttons with light. -24 Vac.-NO and NC contacts. 3-pole Contactor (24Vac (3 units) - 3 pole contactor, 9 A. - Control coil 24 Vac. - Auxiliary contacts 3NO + 2NC.	
54	**Electric motors with speed control and loads**	
	1. Electrical Machines Unit (Basic) Metallic box. Diagram in the front panel. Thermal Magnetic Circuit Breaker. DC supply 200 V dc with fuses. Connection Key. Emergency stop push button. Two push buttons (1NO + 1NC). **2. Network Analyzer** Metallic box. Diagram in the front panel. 3 current inputs, for series intensity. 3 voltage terminals, for each phase measure (R,S,T) and another one for the neutral connection. Control and visualization digital display. Voltage: Range 20 - 500 Vrms. Prec.: 0.5%. Phase to phase - Phase to neutral.	
	Current: Range 0.02 - 5 Arms. Prec.: 0.5%. Frequency: Range 48 to 62 Hz. 0.1Hz. Power: Active, Reactive and Apparent. Range 0.01 to 9900 kW. Prec.: 1%. Power Factor: Power Factor for each phase and average. Range -0.1 to + 0.1. Prec.: 1%. Operating temperature 0 to +50°C. **3. Resistive, Inducive and Capacitance Load Module** - Metallic box. - Diagram in the front panel. - Variable resistive loads: 3 x [150(500 W) - Fixed resistive loads: 3 x [150(500 W) + 150 (500 W)]. - Inductive loads: 3 x [0, 33, 78, 140, 193, 236 mH].(230V /2 A) - Capacitive loads: 3 x [4 x 7 µF]. (400V) **4. DC Shunt- Series Compound Excitation Motor** Power: 250-300W. Speed: 3000 r.p.m. V.excitation: 220 V.D.C. I.Excitation nominal: 0.3A. V.Armature.: 200V D.C. I.Armature nominal: 1.5A. **5. AC Synchronous Alternator Motor** Power: 250-300W. Speed: 3000 r.p.m. Frequency: 50Hz. Connections: Star/triangle. V.excitation nominal: 220V D.C.	
	I.Excitation nominal: 0.59A. V.Armature.: 3x220/380V. **6. Three Phase Asynchronous Motor Squirrel Cage** (750rpm,8poles,550w) Power: 250-300W. Speed: 2769 r.p.m. (50Hz), 3330 r.p.m. (60Hz). Connections: Star/triangle. Frequency: 50/60 Hz. V.Armature:230/400V (50Hz), 250/440V. (60Hz). I.Armature nominal: 1A-0.7A. **7. Three Phase Asynchronous Motor with wound Rotor** Power: 300W. Speed: 1413 r.p.m. Frequency: 50Hz. V.Armature.: 230/400V. I.Armature nominal: 1A-0.7A. **8. Single Phase Asynchronous Motor with Starting Capacitor** Power: 370W. Speed: 2800 r.p.m. Frequency: 50Hz. V.Armature.: 230V. I.Armature nominal: 1.5A. **9. Single Phase Universal Motor** Power: 4-8W. Speed: 480/14000 r.p.m. Frequency: 50Hz.	

ITEM	DESCRIPTION AND SPECIFICATION	
	10. Single Phase Asynchronous Motor with Starting and Running Capacitor	
	V.Armature.: 230/240V. Power: 250W. Speed: 2800 r.p.m. Frequency: 50 Hz. V.Armature: 230V. **11. DC Motor Speed Controller** - Metallic box. - Regulated voltage output up to 320 Vdc. Maximum current output 2 A. - Front panel including: Connections: - Positive, negative and Ground connections. on/OFF switch. - The top side of the unit include a wheel to adjust the DC output voltage up to 320 Vdc. **12. AC Motor Speed Controller** - Metallic box. - Output: 3 PH, 3.0 KVA, 220 V, 1-50 Hz., 8.0 A. - Overload current thermal protection. - on/OFF switch. - It has two blocks in the front panel: - Speed control: - start/stop switch. - speed Control potenciometer. - Connections to motor: - Three-phase connection to AC motor. - Ground connection. **13. Tachogenerator:** - Tachodynamo, 60V, 1000 rpm **14. Electronic Brake** This unit is based in two elements:	
	1. Module -metallic box: Power supply:1 phase, 200-240V. Rated output capacity:0.75 KW. Output frequency range: 0.2 to 400 Hz. Display to visualize voltage (V), Current (A), and Frequency (Hz). Brake resistance included. Torquemeter. R.p.m. Meter. Connectors. 2. Braking motor mounted on a bench-support. Connection wire between elements "1" and "2". **15. Computer Aided Instruction Software System** - complementary to the Modules, formed by: Classroom Management Software Package(Instructor Software) only one is required and common for all software packages(student/module/software) **16. Demonstration Software(Student/Module Software) for a DC Shunt-series compound excitation motor, Single licence**	
55	**(Tables, Teacher's and Students' Chairs, Storage Cabinets) 1 Lot**	
	Laboratory Table (6units) 2440 x 800mm, 30mm laminated board table top with PVC edging, with two cabinets below (with locks)	
	Powder-coated steel casing for table top electrical outlets with removable front plate, powder-coat finish. Includes wiring provisions for eight 2 gang universal outlet Powder-coated Tubular metal framing with perforated plate cover for table legs support and adjustable metal glides. **Teacher's table (1)** 1000x950x780mm Table 18mm Laminated Board with PVC edging Clear glass view panel for rocessed monitor (approx 24" diagonal) **Teacher's chair (1)** Executive type Non Folded Finished Materials: PU + Steel + PP (or better) Back: PU or better Seat: Cutting sponge with PU or better ; Armrest: steel, powder coated or of similar quality Foam: High Density Foam (or equiv/) Steel leg, powder coated steel structure Color: preferably Navy blue **Polypropylene Stacking Chair (45 pcs)** Chair seat & back: high-quality polypropylene, Chair frame: Round steel tube (heavy duty) , high quality electro-static powder coated (or equivalent) Stacks 10 high from the floor Color: Navy blue/ dark blue **Storage Cabinet (1)** 1.20m x 1.90m Sliding Glass doors on powder-coated aluminum frame with lock	

ITEM	DESCRIPTION AND SPECIFICATION	
	18mm laminated boards with PVC edging	
Civil Works (Program of Works, Detailed Cost Estimates, Drawings, etc.		
56	Laboratory Repairs Renovation *(pls see details in approved EDP)*	
	LOT 8- P 8,165,000.00	
8.1 CISCO Networking		
57	**CISCO 2911 w/ 3 GE, 4 EHWIC, 2 DSP, 1 SM, 256MB CF, 512MB DRAM, IPB**	
	- AC Power Cord (North America), C13, NEMA 5-15P, 2.1 m - CISCO 2901-2921 IOS UNIVERSAL - CISCO 2911 AC Power Supply - CISCO Config Pro Express on Router Flash - 512MB DRAM for CISCO 2901-2921 ISR (Default) - 256MB Computer Flash for CISCO 1900, 2900, 3900 ISR - IP Base License for CICSO 2901-2951	
58	**SMARTNET 8X5XNBD for CISCO 2911 Routers**	
59	**2-Port Serial WAN Interface Card (HWIC-2T)**	
60	**CISCO CATALYST 2960-24PC-L**	
	Device Type: Switch - 24 ports - Managed Enclosure Type: Rack-mountable - 1U Interfaces: Fast Ethernet Ports: 24 x 10/100 (PoE) + 2 x combo Gigabit SFP Power Over Ethernet (PoE): PoE Performance Switching capacity: 32 Gbps Forwarding performance (64-byte packet size): 6.5 Mpps MAC Address Table Size: 8K entries Remote Management Protocol: SNMP 1, SNMP 2, RMON 1, RMON 2, RMON 3, RMON 9, Telnet, SNMP 3, SNMP 2c, HTTP, HTTPS, TFTP, SSH	
61	**SMARTNET 8X5XNBD Catalyst 2960-24PC-L**	
62	**Linksys EA Series (2700, 3500, 4500) or equivalent (Wireless N-Router (b/g/n))**	
63	**Branded All-in-one Computer Units**	
	- OPERATING SYSTEM: Windows 8 - DISPLAY: 23.0"(58.4cm), 16:9, Full HD 1920x1080, LED-backlight, 178° wide viewing angle, Touch Screen - Multi Touch(10 Fingers Touch) - PROCESSOR: Intel® Core™ i5-3330 (6M Cache, 3.0 GHz, Turbo Boost up to 3.2GHz) - CHIPSET: Intel® B75 - MEMORY: 8 GB, DDR3 at 1600MHz - STORAGE: 1TB SATA Hard Drive (7200RPM) - WIRELESS DATA NETWORK: 802.11 b/g/n or 802.11 b/g/n + WiDi (Optional) - LAN: 10/100/1000 Mbps - CAMERA: 2 MP - CARD READER: 3-in-1: SD/SDHC/MMC	
64	**45U 2 Welded 4 Por Steel Frame Rack, 35.5" Base deep, 28.75" Post Deep**	
65	**High Performance Wire Stripper**	
	Electrician Tool Type: Wire strippers Application: Cable cutting/stripping Type of Wire: Stranded Handle Length (Inches): 3.0 Lockable: Yes Material: Stainless steel Stripping Capacity: From#18 to #10	
66	**High Performance Phone & Data Crimping Tool**	
	Electrician Tool Type: Data crimper Application: Cuts, strips and crimps phone and data wire Type of Wire: Solid and stranded Crimping Capacity: Phone and data wire Wire Cutting Capacity (Inches): 1.0 Handle Length (Inches): 5.0 Lockable: Yes Material: Metal and plastic Stripping Capacity: Phone and data	
67	**Heavyduty RS232 to USB Adaptor/Converter**	
68	**3ft. CISCO Smart Serial Cable (CAB-SS26X26-3)**	
69	**Digital Network Cable Tester**	

ITEM	DESCRIPTION AND SPECIFICATION	
	Power supply: 4 x 1.5 V DC AA batteries (not included) Power consumption: up to 16 mA Display: 4 x 16 character LCD screen, 61.6 x 25.2 mm Designed for: STP/UTP twin twisted, coaxial & telephone cable Working ambient temperature: -10 ... + 60°C Tester port: tester RJ45 master port (M), tester LOOPBACK RJ45 port (L), far-end recognizer RJ45 port (R) Max cable length: up to 1350 m Calibration accuracy: 3% (+/- 0.5 m) Calibration cable length: > 5 m Cable problems detected: open circuit, short circuit, reverse connection, crossover or cross-talk interference	
70	**INTERACTIVE PROJECTOR**	
	Projection Technology: RGB liquid crystal shutter projection system (3LCD) LCD: Size (0.59" with MLA (D8)), Native Resolution (WXGA)	
	Projection Lens: Type: No Optical Zoom / Focus (Manual) F-Number: 1.80 Focal Length: 3.71mm Zoom Ratio: 1 - 1.35 (Digital Zoom) Throw Ratio: 0.27 - 0.37 (Wide - Tele) Lamp: Type: EB-1400Wi: 190W UHE, EB-1410Wi: 215W UHE Life*[1] (Normal/Eco): 3,500 hours / 5,000 hours Screen Size (Projected Distance): 74.3" screen 0.438m , 60" to 100" [0.348 to 0.597m] Network: Wired LAN: RJ45 x 1 (10/100Mbps) Wireless: Yes (ELPAP07) BASIC SPECIFICATIONS: Technology: Infrared Input Devices: Digital Pen (Easy Interactive Pen 1 and 2) Connection to PC: USB, Network Calibration: Auto / Manual (25points)	
	Functions: Hover, Right click, Auto Adjust Pen Area	
71	**Stacking chairs for students (45 pcs)**	
	• Chair seat & back: high-quality polypropylene, • Chair frame: Round steel tube (heavy duty) , high quality electro-static powder coated • Stacks 10 high from the floor • Color: Navy blue/ dark blue	
72	**Computer Table**	
	- High-pressure laminate top that is 1-1/4" thick with radius corners and vinyl edge banding. - Scratch-resistant, environmentally-friendly, powder-coat paint finish on welded leg assemblies and modesty panel. - Modesty panel features center grommet for wire pass-through. - Adjustable leveling glides. - 24"D table with 30" W; 26" fixed height	
73	**Display Cabinet**	
	- Made with tempered glass panels - 4 tempered glass shelves - Twin lockable tempered glass doors - Chrome plated fittings - 4 Wheels & feet - Twin cupboard doors at bottom - Frameless design - Black Laminate finish - Dimensions: 1016mm (w) x 457mm (d) x 1850mm (h)	
	LOT 11- P 38,061,839.00 (Including Civil Works P 691,839.00)	
	11.1 Advanced Mechatronics Laboratory	
74	**Modular Production System Mechatronics Station with Mechatonics Assistant**	
	1. Distribution Station - PLC Board - Control Panel - Work pieces - Power Supply -PLC software -Programming cable	
	- Low noise compressor - Semi-rotary actuators • swivel arm can be set to various angles between 90° and 270° • end positions are sensed by means of micro switches. • double-acting linear cylinder pushes workpieces out of the stacking magazine - Special grippers: Suction gripper	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Operating pressure 600 kPa (6 bar) • Power supply 24 V DC • 7 digital inputs • 5 digital outputs - Trolley	
	• Height (incl. castors, to bottom edge of profile plate): 750 mm • Width: 350 mm • Depth: 700 mm - Control console • Fully assembled with operating panel, communication panels, spare panel and mounting frame with SysLink connector • Membrane keyboard: Start pushbutton with LED, Stop pushbutton, Reset pushbutton with LED, 2 flexibly assignable control lamps, 4 mm safety sockets with LED status display for simple I/O connection. Syslink and Sub-D sockets for connection to PLC of choice are available on the rear panel • fully assembled with AS-interface control console, communication panels, spare panel and mounting frame with AS-interface connector. - Programmable Logic Controller-EduTrainer Universal Preferred versions MPS®/MPS® PA A4 rack with built-in power supply 24 V DC power supply integrated • 32 bit MIPS processor, 400 MH • Data memory 32 MB flash/32 MB • 20 MB flash/8 MB RAM user memory • 32 KB non-volatile memory • Communication network Ethernet 10/100 Base-T • Integrated web server • Master CANopen • Diagnostic handheld for CPX terminal can be connected Desktop Computer (1 set) Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better - Aluminium profile plate • 350 x 700 mm • Grid Dimension: 50mm - Cable holder - Changer module CP • Cylinder rotation angle (rotary cylinder): 180° (freely selectable)	
	• Height: 130 mm ,Width: 130 mm , Length: 250 mm - CP Valve terminals - Electrical mounting system • Comprising: 2 cable ducts 340 mm and DIN rail 340mm, with mounting accessories for securing to profile plate. - Minor accessories - On-off valve with filter regulating valve • Filter regulator with pressure gauge, on-off valve, quick push-in connections and quick couplings, mounted on a swivel support - Profile plate connector - Stacking magazine module • Consisting of double-acting cylinder with inductive sensors and cables, magazine separator and magazine tube. The speed with which The cylinder extends and retracts can be set via one-way flow control valves. • Height: 280 mm • Width: 60 mm • Length: 290 mm - Station link receiver - Through beam sensor	
	• Nominal switching distance: 80 mm • Power supply: 24 V DC • Switch output: PNP, normally open/normally closed contact • Connection cable: 4-pin - Vacuum switch • Mechanical vacuum switch (pneumatic-electric pressure transduction) with adjustable switching point and switching status display (LED) •Mechanical vacuum switch with adjustable switching point and switching status display (LED) - Compressor : Silent type, 1 unit Oil-lubricated, Extremely quiet (45 dB (A)) compressor. With pressure regulator and water separator.Pressure: 800 kPa (8 bar) Pmax, Performance: 50 l/min, Reservoir capacity: 24 l, Compressed air outlet: ¼“ or KD4, Noise level: 45 dB (A)/1 m, Duty cycle: max. 50 %, Pressure regulator valve with gauge, Design: 230 V/50 Hz **2. Testing Station** - PLC Board - Control Panel - Work pieces - Power Supply - PLC software - Programming cable - Sensors: The Testing station employs all basic types of industrial sensors in typical applications:	

ITEM	DESCRIPTION AND SPECIFICATION	
	optical capacitive proximity sensors and optical retro-reflective sensors.	
	supplemented by various cylinder limit switches (inductive, magnetic). -Technical data • Operating pressure 600 kPa (6 bar) • Power supply 24 V DC • 8 digital inputs • 5 digital outputs - Trolley • Height (incl. castors, to bottom edge of profile plate): 750 mm • Width: 350 mm • Depth: 700 mm - Control console • Fully assembled with operating panel, communication panels, spare panel and mounting frame with SysLink connector • Membrane keyboard: Start pushbutton with LED, Stop pushbutton, Reset pushbutton with LED, 2 flexibly assignable control lamps, 4 mm safety sockets with LED status display for simple I/O connection. Syslink and Sub-D sockets for connection to PLC of choice are available on the rear panel • fully assembled with AS-interface control console, communication panels, spare panel and mounting frame with AS-interface connector. -Programmable Logic Controller-EduTrainer Universal Preferred versions MPS®/MPS® PA A4 rack with built-in power supply 24 V DC power supply integrated	
	• 32 bit MIPS processor, 400 MH • Data memory 32 MB flash/32 MB • 20 MB flash/8 MB RAM user memory • 32 KB non-volatile memory • Communication network Ethernet 10/100 Base-T • Integrated web server • Master CANopen • Diagnostic handheld for CPX terminal can be connected • 1 set Desktop computer Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better - Cable guide - Cable holder - CP valve terminals - Electrical mounting system - Lifting module - Measuring module • Linear displacement sensor (conductive plastic potentiometer): Measuring range: 25 mm Resistance: 1 k. • Comparator:	
	Nominal switching distance: up to max. 400 mm (adjustable) Power supply: 24 V DC Switch outputs: 3, PNP, normally open contact Analogue input: 0 – 10 V - On-off valve with filter regulating valve • Filter regulator with pressure gauge, on-off valve, quick push-in connections and quick couplings, mounted on a swivel support. - Pneumatic slide module - Profile plate connector - Recognition module • comprises two different sensors and a mounting bracket • Power supply: 24 V DC • Switch outputs: PNP, normally open contact • Connection cable: 3-pin • Capacitive sensor: 2 – 8 mm (adjustable) • Optical sensor: up to max. 400 mm (adjustable) - Retro-reflective sensor - Station link receiver - Slide module • universally mounted on a profile. • can be adjusted by means of the flow control valve on the underside of the slide • Length: 220 mm • Operating pressure: 600 kPa (6 bar) - Workpiece set “Cylinder bodies” **3. Processing Station** - PLC Board - Control Panel - Work pieces - Power Supply - PLC software - Programming cable - Drilling operation	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Power supply 24 V DC • 8 digital inputs • 8 digital outputs - Trolley • Height (incl. castors, to bottom edge of profile plate): 750 mm • Width: 350 mm • Depth: 700 mm - Control console • Fully assembled with operating panel, communication panels, spare panel and mounting frame with SysLink connector	
	• Membrane keyboard: Start pushbutton with LED, Stop pushbutton, Reset pushbutton with LED, 2 flexibly assignable control lamps, 4 mm safety sockets with LED status display for simple I/O connection. Syslink and Sub-D sockets for connection to PLC of choice are available on the rear panel • fully assembled with AS-interface control console, communication panels, spare panel and mounting frame with AS-interface connector. - Programmable Logic Controller-EduTrainer Universal Preferred versions MPS®/MPS® PA A4 rack with built-in power supply 24 V DC power supply integrated • 32 bit MIPS processor, 400 MH • Data memory 32 MB flash/32 MB • 20 MB flash/8 MB RAM user memory • 32 KB non-volatile memory • Communication network Ethernet 10/100 Base-T • Integrated web server • Master CANopen • Diagnostic handheld for CPX terminal can be connected 1 set Desktop computer Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better - Aluminium profile plate • 350 x 700 mm • Grid Dimension: 50mm - Cable holder - Clamping/ejecting module - For mounting on a profile plate. - An electrical solenoid is used for the drive - Drive, with working stroke of 9 mm. - For mounting directly on the conveyor. • Working stroke: 9 mm • Voltage: 24 V DC • Output: 7 W - Drilling module • Height: 360 mm • Working stroke: 100 mm • Power supply: 24 V DC • Nominal current DC motor: 0.3 A • Nominal current drill: 0.5 A - Electrical mounting system - Profile plate connector - Relay - Rotary indexing table module	
	• Rotary indexing table with 6 workpiece positions. The table is driven by a DC-geared motor with a series resistor. • Workpiece positions: 6 • Diameter: 350 mm • Height: 125 mm • Nominal voltage: 24 V	
	• Nominal rotational speed: 6 r.p.m. (with series resistor 47.) • Nominal current: 0.15 A (with series resistor 47.) • Nominal current: 0.5 A • The end positions (6 x 60°) can be sensed by means of an optional inductive sensor. An optional capacitive sensor for workpiece sensing can also be mounted under each workpiece position. - Sensor, inductive • Inductive sensor for end-position interrogation on the rotary indexing table Nominal switching distance: 2.5 mm • Power supply: 24 V DC • Switch output: PNP, normally open contact • Connection cable: 3-pin - Sorting gate module, electrical C34 - Branch module, electrical: For mounting on a profile plate. Voltage 24 V DC Rating 7 WFor mounting on a profile plate. An electrical solenoid is used for the drive • Voltage: 24 V DC • Output: 7 W - Station link receiver - Testing module • consists of a solenoid probe with an inductive sensor for sensing.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• used for the testing of workpieces: simple drill-hole checking, simple height checking, workpiece position checking. - Solenoid actuator: • Working stroke: 10 mm • Voltage: 24 V DC • Output: 7 W - Inductive sensor: • Nominal switching distance: 2.5 mm • Power supply: 24 V DC • Switch output: PNP, normally open contact • Connection cable: 3-pin **4. Handling Station** - PLC Board - Control Panel -Work pieces -Power Supply - PLC software - Programming cable -Technical data • Operating pressure 400 kPa (4 bar) • Power supply 24 V DC • 8 digital inputs • 5 digital outputs - Control console • Fully assembled with operating panel, communication panels, spare panel and mounting frame with SysLink connector	
	• Membrane keyboard: Start pushbutton with LED, Stop pushbutton, Reset pushbutton with LED, 2 flexibly assignable control lamps, 4 mm safety sockets with LED status display for simple I/O connection. Syslink and Sub-D sockets for connection to PLC of choice are available on the rear panel • fully assembled with AS-interface control console, communication panels, spare panel and mounting frame with AS-interface connector. - Programmable Logic Controller-EduTrainer Universal Preferred versions MPS®/MPS® PA A4 rack with built-in power supply 24 V DC power supply integrated • 32 bit MIPS processor, 400 MH • Data memory 32 MB flash/32 MB • 20 MB flash/8 MB RAM user memory • 32 KB non-volatile memory • Communication network Ethernet 10/100 Base-T • Integrated web server • Master CANopen • Diagnostic handheld for CPX terminal can be connected 1 set Desktop computer Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better - Compressor: Silent type, 1 unit Oil-lubricated, Extremely quiet (45 dB (A)) compressor. With pressure regulator and water separator.Pressure: 800 kPa (8 bar) Pmax, Performance: 50 l/min, Reservoir capacity: 24 l, Compressed air outlet: ¼" or KD4, Noise level: 45 dB (A)/1 m, Duty cycle: max. 50 %, Pressure regulator valve with gauge, Design: 230 V/50 Hz - Aluminium profile plate • 350 x 700 mm • Grid Dimension: 50mm - PicAlfa module, pneumatic • Universal 2-axis handling device for "Pick & Place" tasks. Stroke length, inclination of the axes and arrangement of the end-position sensors and mounting position can be adjusted. • Linear drive: 600 mm stroke length, 3 end-position sensors • Flat cylinder: 80 mm stroke length, 2 end-position sensors • Pneumatic gripper • Height: 700 mm • Width: 220 mm • Length: 730 mm • gripper - Holder module -Diffuse sensor • diffuse sensor can be mounted directly in the pickup module, at the end of a slide or on a gripper - complete with bracket for mounting on a profile or profile plate - diffuse sensor includes a holder for mounting on the conveyor guide rail profile or a slide. • Nominal switching distance: 30 mm • Power supply: 24 V DC • Switch output: PNP, normally open/normally closed contact • Connection cable: 4-pin	
	- Slide module	
	• with a retainer for mounting on a profile plate	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Application: As end slide or segregating slide • Length: 250 mm • Standard height: 117 – 20 mm (adjustable) - CP valve terminals - On-off valve with filter regulating valve • Filter regulator with pressure gauge, on-off valve, quick push-in connections and quick couplings, mounted on a swivel support. - Profile plate connector - Station link receiver - Electrical mounting system - Cable holder **5. Sorting Station** - PLC Board - Control Panel - Work pieces - Power Supply - PLC Software - Programming cable Sorting gates with short-stroke cylinder Sensors Guide rails Conveyor motor - **Technical data** • Operating pressure 600 kPa (6 bar) • Power supply 24 V DC • 8 digital inputs • 4 digital outputs - Trolley • Height (incl. castors, to bottom edge of profile plate): 750 mm • Width: 350 mm • Depth: 700 mm - Control console • Fully assembled with operating panel, communication panels, spare panel and mounting frame with SysLink connector • Membrane keyboard: Start pushbutton with LED, Stop pushbutton, Reset pushbutton with LED, 2 flexibly assignable control lamps, 4 mm safety sockets with LED status display for simple I/O connection. Syslink and Sub-D sockets for connection to PLC of choice are available on the rear panel • fully assembled with AS-interface control console, communication panels, spare panel and mounting frame with AS-interface connector. - Programmable Logic Controller-EduTrainer Universal Preferred versions MPS®/MPS® PA A4 rack with built-in power supply 24 V DC power supply integrated	
	• 32 bit MIPS processor, 400 MH • Data memory 32 MB flash/32 MB • 20 MB flash/8 MB RAM user memory • 32 KB non-volatile memory • Communication network Ethernet 10/100 Base-T • Integrated web server • Master CANopen • Diagnostic handheld for CPX terminal can be connected	
	1 set Desktop computer Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better - Aluminium profile plate • 350 x 700 mm • Grid Dimension: 50mm - Cable holder - Conveyor module 350 with DC motor • complete with DC motor • For the transport of workpieces of 40 mm diameter (or for the transport of workpiece carriers) • Transport distance: 350 mm • DC motor: 24 V DC/1.5 A - CP valve terminals - Diffuse sensor - Electrical mounting system - Inductive sensor - On-off valve with filter regulating valve • quick push-in connections and quick couplings, mounted on a swivel support - Profile plate connector - Retro-reflective sensor • complete with brackets for mounting on a profile or profile plate. • Operating distance: 10 – 700 mm • Power supply: 24 V DC • Switch output: PNP, normally open/normally closed contact • Connection cable: 4-pin - Set of guide rails, Sorting • Operating distance: 10 – 700 mm	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Power supply: 24 V DC • Switch output: PNP, normally open/normally closed contact • Connection cable: 4-pin - Slide module - Sorting gate module, pneumatic - Starting current limiter • can be mounted on a DIN rail. Electrical connection is by means of screw terminals • Control voltage: 24 V DC • Current: 1 A	
	• Current limitation at switching torque: to 2 A - Stopper module • Complete with double-acting short-stroke cylinder, sensors and cable with mounting accessories for conveyor profile • For mounting on a conveyor. Complete with one double-acting short-stroke cylinder, two sensors for end-position sensing and mounting accessories. **6. Mechatronic assistant** 7. Coloured Laser Printer : Docuprint, 5ppm colour and 25ppm monochrome print speed (or better) 8. Package should come with complete training program, laboratory manuals/workbooks, and after sales support.	
75	**Complete Robotic System and Assembly Station**	
	A. Robotic System High-precision	
	6-axis articulated arm robot with extended mobility for minimal cycle times. Complete with : controller, programming cable, 1 set of batteries and the Teachbox The Robot station transports workpieces that are fed via a slide and place them in an assembly retainer. The sensor in the gripper to enable the robot to differentiate workpieces by colour (black/non-black). The sensor in the assembly retainer to monitor the orientation of the workpiece. From the assembly retainer the robot sorts the workpieces into various magazines or passes them on to the downstream station. Combination with the assembly station facilitates the assembly of workpieces. The new drive unit is small, powerful and lightweight and fits into the MODULAR PRODUCTION SYSTEM (MPS). **Technical data:** • Operating pressure 6 bar (600 kPa) • Power supply 24 V DC • 4 digital inputs • 2 digital outputs > Training aims for project work Mechanical: • Mechanical set-up of a station Sensors: Correct application of limit switches PLC: • Programming and application of a PLC Robotics: • Applications of robots • Fundamentals of robotics	
	• Robot terminology • Robot programming Assembly technology: • Introduction to and application of automated assembly technologies • Planning an assembly station Commissioning: Commissioning of the entire sequence *Accessories/Components:* Silent type Compressor Oil-lubricated, Extremely quiet (45 dB (A)) compressor. With pressure regulator and water separator.Pressure: 800 kPa (8 bar) Pmax, Performance: 50 l/min, Reservoir capacity: 24 l, Compressed air outlet: ¼“ or KD4, Noise level: 45 dB (A)/1 m, Duty cycle: max. 50 %, Pressure regulator valve with gauge, Design: 230 V/50 Hz 1 set desktop computer Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better 1. Trolley • Height (incl. castors, to bottom edge of profile plate): 750 mm, Width: 350 mm, Depth: 700 mm 2. Workpiece set “For cylinder assembly”	
	The workpiece set consisting of cylinder components for full assembly (body, piston, spring, cover). The cylinders can be assembled and dismantled many times. • External diameter: 40 mm • Height (black): 22.5 mm • Height (red and aluminium): 25 mm	

ITEM	DESCRIPTION AND SPECIFICATION	
	3. Tabletop power supply unit • Input voltage: 85 – 265 V AC (47 – 63 Hz) • Output voltage: 24 V DC, short-circuit-proof • Output current: max. 4.5 A • Dimensions: 75 x 155 x 235 mm 4. Programming instructions for robot 5. Technical manual for robot 6. Robotics Simulation software - technical documentation including instructions on processing. - 3D real-time simulation - Programming environment for IRL (Industrial Robot Language), programming languages Movemaster Command and robot systems. - Library with pick & place tasks 7. Aluminium profile plate • Sizes: 350 x 700 mm • Grid Dimension: 50mm 8. Cable holder 9. Angle Slide module The slide comes complete with a retainer for mounting on a profile plate. •Application: As angled end slide or segregating slide •Length: 170 mm •Standard height: 170 - 100 mm (adjustable) The slide comes complete with a retainer for mounting on a profile plate. • Application: As angled end slide or segregating slide • Length: 170 mm • Standard height: 170 – 100 mm (adjustable) 10. CP valve standalone	
	11. Electrical mounting system 12. Diffuse sensor • Nominal switching distance: 30 mm • Power supply: 24 V DC • Switch output: PNP, normally open/normally closed contact • Connection cable: 4-pin 13. On-off valve with filter regulating valve - Filter regulator with pressure gauge, on-off valve, quick push-in connections and quick couplings, mounted on a swivel support. 14. Piston pallet – Pallet for the storage of 4 pistons (“Cylinder for assembly” workpiece set). (10 mm diameter and 16 mm diameter from workpiece set "For cylinder assembly"). - Pallet size: 2 x 4 locations - Height: 20 mm - Width: 90 mm - Length: 140 mm 15. Gripper, pneumatic	
	16. Profile plate connector - Length: 45 mm - Mounting method: Bolt with rotating head and M6 hammer-head nut 17. Separating module (springs) - Height: 260 mm - Width: 70 mm - Length: 220 mm 18. Slide module - Height: 260 mm - Width: 70 mm - Length: 220 mm 19. Stacking magazine module (end caps) - Height: 190 mm - Width: 60 mm - Length: 290 mm 20. Station link receiver 21. Through beam sensor - Nominal switching distance: 80 mm - Power supply: 24 V DC - Switch output: PNP, normally open/normally closed contact - Connection cable: 4-pin 22. Holder module The Holder module comes complete with a holder for mounting on a profile plate. - Application: As horizontal workpiece holder at the end of an inclined slide - Standard height: 40 – 60 mm (adjustable)	
	23. • Retaining module • The retaining module has two setdown positions. The upper setdown position allows workpieces to be set down independent of their orientation. The lower setdown position has a locking pin. Workpieces (cylinder bodies) have to be inserted in the correct orientation. • The holding pin ensures that the cylinder body does not turn during assembly of the cap. • Inclusive Teachdorn for robot	

ITEM	DESCRIPTION AND SPECIFICATION	
	24. Terminals and series resistors 25. Robot Teachbox **B. Assembly station** The assembly station works in conjunction with the robot station. It supplies cylinder components for the assembly process: A double-acting cylinder pushes the cylinder caps out of the stacking magazine. The pistons are stored on a pallet. A double-acting cylinder pushes the springs out of a slim magazine. Technical data: - Operating pressure 6 bar (600 kPa) - Power supply 24 V DC - 8 digital inputs - 3 digital outputs Accessories/Components: 1. Trolley - Height (incl. castors, to bottom edge of profile plate): 750 mm - Width: 350 mm	
	- Depth: 700 mm 2. Control console - Fully assembled with operating panel, communication panels, spare panel and mounting frame with SysLink connector. - Membrane keyboard: Start pushbutton with LED, Stop pushbutton, Reset pushbutton with LED, 2 flexibly assignable control lamps, 4 mm safety sockets with LED status display for simple I/O connection. Syslink and Sub-D sockets for connection to PLC of choice are available on the rear panel. - fully assembled with AS-interface control console, communication panels, spare panel and mounting frame with AS-interface connector. 3. Programmable Logic Controller-EduTrainer Universal Preferred versions - A4 rack with built-in power supply 24 V DC power supply integrated - 32 bit MIPS processor, 400 MH - Data memory 32 MB flash/32 MB - 20 MB flash/8 MB RAM user memory - 32 KB non-volatile memory - Communication network Ethernet 10/100 Base-T - Integrated web server - Master CANopen	
	- Diagnostic handheld for CPX terminal can be connected - All FEDs can be connected via Ethernet - Visualisation OPC server for connection to any SCADA packages 4. Aluminium profile plate - 350 x 700 mm - Grid Dimension: 50mm 5. Cable holder 6. CP valve terminals 7. Electrical mounting system 8. On-off valve with filter regulating valve - Filter regulator with pressure gauge, on-off valve, quick push-in connections and quick couplings, mounted on a swivel support. 9. Piston pallet - Pallet for the storage of 4 pistons (“Cylinder for assembly” workpiece set). (10 mm diameter and 16 mm diameter from workpiece set "For cylinder assembly"). - Pallet size: 2 x 4 locations - Height: 20 mm - Width: 90 mm - Length: 140 mm 10. Profile plate connector 11. Separating module (springs) - Height: 260 mm - Width: 70 mm - Length: 220 mm The module separates springs (“Cylinder for assembly” workpiece set) from a gravity-fed magazine and makes them available to the assembly process. A double-acting cylinder moves the springs to the transfer point. A micro switch detects whether there is a spring in the transfer point.	
	12. Slide module The slide comes complete with a retainer for mounting on a profile plate. 13. Stacking magazine module (end caps) - Height: 190 mm - Width: 60 mm - Length: 290 mm 14. Station link receiver Through beam sensor - Nominal switching distance: 80 mm - Power supply: 24 V DC - Switch output: PNP, normally open/normally closed contact - Connection cable: 4-pin 15. Desktop computer (1set) Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better	

ITEM	DESCRIPTION AND SPECIFICATION	
76	**SCADA system and visualization with control and monitoring system**	
	System visualization and operation on basis of industrial SCADA software. communication between SCADA and controllers takes place via Profibus DP. PC-based control and monitoring system designed for the visualization and control of processes, sequences and machines.The package consists of a configuration (development) system and a runtime system for 1024 variables (PowerTags). Coupling with S5, S7, Profibus (DP) is integrated into the system. Coupling with other systems on request. Supplied on CD-ROM. The SCADA system includes a Personal computer with TFT monitor (Specs: Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better)	
77	**Conveyor system:**	
	MPS 500 - MPS with Interface to Stations - Dimensions main loop: 3000 X 500 mm - Base: aluminum profiles - Track with: 40mm - Identifications System: 6 inductive sensors for identification of pallets - Interface to stations: 6X8 inputs / 8 outputs Syslink terminal IEEE488 24 pin - Pneumatic valves: 6 valves (5/2 way) - Number of stop gates: 6 - Stopper: short stroke cylinder type AEVUZ, stroke 10mm - Motor data: 4 motors, 3 phase 220 V - Workpiece carriers: 8 carriers, dimensions: 9x8 cm with pallet (11x16.4 cm) - Transportation speed: p to 9m/min - Total number of sensors: 24 (18X inductive, 6x light barrier) - Total number of pn actuators: 6 short stroke cylinders - Control cabinet: PLC board with frequency controller for speed variations - Motor control: frequency converter - Communication to I/O: AS interface	
	- Emergency stop system: emergency stop boards with two buttons on the system - Operation panel: ON/OFF/ERROR/CONTROLLER - Pneumatic maintenance unit: pressure gauge, water separator, 3/2 way valve manually actuated - Operation pressure: 6 bar - Power supply: 220 V VDC with PLC 16 DI/DO, 4 Analog Input, 2 Analog Output	
78	**Vision Inspection Station**	
	Sensor: 1/3" CMOS colour global shutter progressive scan Resolution: 752 x 480 Pixel Optics CS-Mount, C-Mount Digital I/O 2 Inputs, 3 Outputs Light Integrated ring LED light	
	External Port, for 10/100 Mbps Ethernet connection PLC 16 DI/DO, 4 Analog Input, 2 Analog Output	
79	**Automation Suite for Robot and Mechatronics System and Handling station**	
	The Automation Suite simulation software: Automation Suite Robotics Automation Suite Mechatronics Automation Suite Advanced Mechatronics Automation Suite Production Production Simulation Supervision Production data management Automation Suite Studio **Handling station, pneumatic: All-rounder with pneumatic linear drive:** **Technical data** Operating pressure 400 kPa (4 bar) Power supply 24 V DC 8 digital inputs 5 digital outputs **Training aims for project work** Mechanical: Mechanical set-up of a station Pneumatics: Installation of tubing for pneumatic components Pneumatic grippers Pneumatic linear drives Electrical: Correct wiring of electrical components Sensors: Correct application of limit switches PLC: Programming and application of a PLC Control of a handling device Commissioning: Commissioning of the entire sequence Optimisation of cycle time	

ITEM	DESCRIPTION AND SPECIFICATION	
	Safety in the event of loss of pneumatic or electrical power **Accessories/Components:** Desktop Computer (1 unit) Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better	
	1. Trolley The trolley makes an MPS® station a compact and mobile unit. The station is easy to mount on the trolley. An EMERGENCY-STOP board can also be fitted. Appropriate through-holes in the side and rear panels enable orderly routing of cables. The front side is equipped with mountings for the control panel. The trolley is supplied complete with castors. Height (incl. castors, to bottom edge of profile plate): 750 mm Width: 350 mm Depth: 700 mm 2. Control console - allows simpler operation of the MPS® station. SysLink or AS-interface – various interfaces ensure versatility of use. Fully assembled with operating panel, communication panels, spare panel and mounting frame with SysLink connector.	
	- Membrane keyboard: Start pushbutton with LED, Stop pushbutton, Reset pushbutton with LED, 2 flexibly assignable control lamps, 4 mm safety sockets with LED status display for simple I/O connection. Syslink and Sub-D sockets for connection to PLC of choice are available on the rear panel. - fully assembled with AS-interface control console, communication panels, spare panel and mounting frame with AS-interface connector. 3. Programmable Logic Controller-EduTrainer Universal Preferred versions - rack with built-in power supply 24 V DC power supply integrated -32 bit MIPS processor, 400 MH+D1209:D1228 - Data memory 32 MB flash/32 MB - 20 MB flash/8 MB RAM user memory - 32 KB non-volatile memory - Communication network Ethernet 10/100 Base-T - Integrated web server - Master CANopen - Diagnostic handheld for CPX terminal can be connected - All FEDs can be connected via Ethernet - Visualisation OPC server for connection to any SCADA packages 4. Aluminium profile plate - 350 x 700 mm - Grid Dimension: 50mm 5. PicAlfa module, pneumatic Universal 2-axis handling device for “Pick & Place” tasks. Stroke length, inclination of the axes and arrangement of the end-position sensors and mounting position can be adjusted. - Linear drive: 600 mm stroke length, 3 end-position sensors - Flat cylinder: 80 mm stroke length, 2 end-position sensors - Pneumatic gripper - Height: 700 mm - Width: 220 mm - Length: 730 mm - gripper 6. Holder module 7. Diffuse sensor	
	The fibre optic diffuse sensor can be mounted directly in the pickup module, at the end of a slide or on a gripper.The diffuse optical sensor comes complete with bracket for mounting on a profile or profile plate. The fibre-optic diffuse sensor includes a holder for mounting on the conveyor guide rail profile or a slide. - Nominal switching distance: 30 mm - Power supply: 24 V DC - Switch output: PNP, normally open/normally closed contact - Connection cable: 4-pin 8. Slide module The slide comes complete with a retainer for mounting on a profile plate. - Application: As end slide or segregating slide - Length: 250 mm - Standard height: 117 – 20 mm (adjustable) 9. CP valve terminals 10. On-off valve with filter regulating valve Filter regulator with pressure gauge, on-off valve, quick push-in connections and quick couplings, mounted on a swivel support. 11. Profile plate connector 12. Station link receiver 13. Electrical mounting system 14. Cable holder 15. Silent type Compressor	

ITEM	DESCRIPTION AND SPECIFICATION	
	Oil-lubricated, Extremely quiet (45 dB (A)) compressor. With pressure regulator and water separator.Pressure: 800 kPa (8 bar) Pmax, Performance: 50 l/min, Reservoir capacity: 24 l, Compressed air outlet: ¼" or KD4, Noise level: 45 dB (A)/1 m, Duty cycle: max. 50 %, Pressure regulator valve with gauge, Design: 230 V/50 Hz	
80	**Robotics Starter Kit**	
	Compatible with LABView Specifications: 1. Ultrasonic Sensor Supply voltage: 5VDC Supply Current: 30 mA, typ; 35 mA max - Range: 2cm to 3cm Input trigger: positive TTL pulse, 2microS min, 5microS typ - Echo pulse: positive pulse, 115 microS to 18.5 ms - Echo holdoff: 750 micros from fall of trigger pulse 2. Burst frequency: 40 kHz for 200 microS - Burst indicator: LED shows sensor activity Delay before next measurement: 200 microS - Size(HxWxD): 2mmx46mmx16mm 3. DC Motors Supply voltage: 12V Torque: 300 oz-in. RPM: 152 -Encoders Supply voltage: 5V - Cycles per revo: 100 CPR Pulses per revo: 400 PPR 4. NI sbRIO-9632 Network Network interface: 10 BaseT and 100BaseTX - Ethernet	
	Compatibility: IEEE 802.3 Communication rates: 10 Mbps, 100 Mbps, auto-negotiated - Max cabling distance: 100 m/segment 5. RS-232 DTE Serial Port Baud rate support: Arbitrary Max baud rate: 115,200 bps Data bits: 5, 6, 7,8 Stop bits: 1, 2 Parity: Odd, Even, Mark, Space, None Flow control: RTS/CTS, XON/XOFF, DTR/DSR, None 6. Processor Speed NI sbRIO-9611/9631/9641: 266 MHz NI-sbRIO-9612,9632/9642 and NI sbRIO-96x2XT: 400MHz 7. Memory Non-volatile Memory: NI sbRIO-9611/9631/9641:128 MB NI-sbRIO-9612,9632/9642 and NI sbRIO-96x2XT: 256 MB System memory NI sbRIO-9611/9631/9641:64 MB NI-sbRIO-9612,9632/9642 and NI sbRIO-96x2XT: 128 MB 8. Xilinx Spartan-3 Reconfigurable FPGA Number of logic cells NI sbRIO-9611/9631/9641:17,280	
	NI-sbRIO-9612,9632/9642 and NI sbRIO-96x2XT: 46,080 Available embedded RAM NI sbRIO-9611/9631/9641: 432 kbits NI-sbRIO-9612,9632/9642 and NI sbRIO-96x2XT: 720 kbits 9. 3.3 V Digital I/O Number of DIO channels: 110 Max tested current per channel: 3 mA Max total current, all lines: 330 mA Max tested DIO frequency: 10 mHz Input logic levels Input high voltage, VIH: 2.0 V min; 5.25 V max Input low voltage, VIL: 0 V min; 0.8 V max Output logic levels Output high voltage, VOH, sourcing 3mA: 2.7 V min; 3.3 V max Output low voltage, VOL, sinking 3 mA: 0.07 V min; 0.54 V max Overvoltage protection (max 2 pins in overvoltage) NI sbRIO-961x/963x/964x (-20 to 550C): ±20 V NI sbRIO-96x2XT (-20 to 85oC): ±20 V (-24 to -20oC): ±7 V Posistor (PR18BB330MS1RB from Murata) Max peak abnormal-condition current: 760 mA Max hold current at 25oC: 36 mA Max hold current at 70oC: 20 mA	

ITEM	DESCRIPTION AND SPECIFICATION	
	Max hold current at 85oC (NI sbRIO-96x2XT only): 3 mA Trip current at 25oC: 71 mA Resistance at 25oC: 33 Ω ±20% 10. Analog input Number of channels: 32 single-ended or 16 differential analog input channels ADC resolution: 16 bits Differential nonlinearity: no missing codes guaranteed	
	Integrated nonlinearity: refer to AI Absolute Accuracy tables and formulas Conversion time: 4.00 microS(250 kS/s) Input coupling: DC Nominal input ranges: ±10 V, ±5 V, ±1 V, ±0.2 V Minimum overrange (10 V range): 4% Max working voltage for analog inputs (signal + common mode): within ±10.4 V each channel Input impedance (AI-to-AI GND) Powered on: >10 G Ω in parallel with 100 pF Powered off/overload: 1.2 k Ω miN Crosstalk (at 100 kHz) Adjacent channels: -65 dB Non adjacent channels: -70 dB Small signal bandwith: 700 kHz Over voltage protection AI channel: ±24 V (one channel only) AISENSE: ±24 V CMRR (DC to 60 Hz): 62 dB ±120 ppm of full-scale step (±8 LSB): 4 µS convert interval, 5.5 µS (from 50 to 85oC)	
	±30 ppm of full-scale step (±2 LSB): 8 µS convert interval Analog triggers Number of triggers: 1 Resolution: 10 bits, 1 in 1,024 Bandwidth (-3 dB): 700 kHz Accuracy: ±1% of full size 11. Analog Output (NI sbRIO-963x/9632XT and NI sbRIO-964x/9642XT Only) Analog input channels: 4 DAC resolution: 16 bits Type of DAC: string Output range: ±10V Operating Voltage Nominal: ±10.7 V Minimum: ±10.3 V Maximum: ±11 V Current drive: ±3 mA per channel Output impedance: ±10 V Stability Offset drift: 80 µV/oC Gain drift: 6 ppm/oC Protection Overvoltage: ±25 V at 25 oC Short-circuit: indefinitely Power on voltage: 0 V Update time One channel in use: 3 µs Two channels in use: 5µs Three channels in use: 7.5 µs Four channels in use: 9.5 µs Noise Updating at 100 kS/s: 600 µVrms Not updating: 260 µVrms Slew rate: 4 V/µs Crosstalk: 76dB	
	Setting time (100 pF load to 1 LSB) FS step: 20 µs 3 V step: 10 µs 0.1 V step: 8 µs Glitch energy (256 steps, worst case): 2 mV for 2 µs Capacitive drive: 1,500 pF min Monotonicity: 16 bits Differential nonlinearity: -1 to 2 LSBs max Integrated nonlinearity (endpoint): 16 LSBs max 12. Power Limits 5 V pins (P2, P3, P4, P5): +5 V ±5%, 2 A max (shared with C series modules) 13. Power Requirements Power supply voltage range: 19-30 VDC Power supply current limit: 1.8 A Power connector internal fuse: 2 A (non-replaceable) Max Pint NI sbRIO-961x/9612XT: 7.50 W	

ITEM	DESCRIPTION AND SPECIFICATION	
	NI sbRIO-963x/9632XT: 7.75 W NI sbRIO-964x9642XT: 8.00 W Max PDIO:1.28 W PDIO = Total DIO Current x 3.3 V/0.85 Max P5V P5V = Total 5 V Output Current x 5 V/0.9 Max PCSer: 3.3 W; each installed C series module consumes up to 1.1 W Back-up battery: 3 V lithium coin cell, BR2032 (-40 to 85 oC) 14. Safety Voltages V terminal to C terminal: 35 VDC max, measurement category 1) 15. Environmental NI sbRIO-96xx//96x2XT: intended for indoor use only Ambient temperature in enclosure (IEC 60068-2-1, IEC 60068-2-2) NI-sbRIO-96x/963x/964x: -20 to 55 oC NI-sbRIO-96x/2XT: 40 to 85 oC Storage temperature (IEC 60068-2-1, IEC 60068-2-2): 40 to 85 oC Operating humidity (IEC 60068-2-56): 10 to 90% RH, noncondensing Storage humidity (IEC 60068-2-56): 5-95% RH, noncondensing Maximum altitude: 2,000 m Pollution degree (IEC 60664): 2 16. Physical characteristics Torque for screw terminals on J3: 0.5 to 0.6N, m (4.4 to 5.3 lb.in) Weight: 269.3 g. (9.5 oz)	
81	**Sensors for Object Detection and Vacuum Technology**	
	1. Advanced level: Vacuum technology(2units) Each unit consists of the ff. Accessories/Components: - Air pressure reservoir, 0.4 l - for generating static pressure with the aid of a one-way flow control valve, for the generation of long time delays in conjunction with time-delay and flow control valves, for compensation of pressure fluctuations, as reservoir for sudden pressure drop, and for generation of a control system with a delay of the 1st order. • Design: Brazed tank • Capacity: 400 ml	
	• Pressure range: 0 – 1600 kPa (0 – 16 bar) - Pressure switch, 0 – -1 bar • Pressure switch (piezo-resistive relative pressure transducer) with built-in amplifier and temperature compensator on Quick-Fixsafety and quick mounting plate for profile platesRotatable, 90° detenting • Switching function N/O or N/C contact (PNP) • Operating voltage range 15 – 30 V DC • Idle current max. 30 mA • M8x1 connector, 4-pin • Cable with M8 socket and 4 mm safety plug • Switching output positive switching (PNP) • Output current max. 100 mA • Reverse-polarity • Short circuit/overload protection (clocking) • Nominal pressure range 0 – -1 bar • Overload pressure (short-time) max. 5 bar - Vacuum gauge Adjustable red/green range Indicating range/operating pressure -1 – 0 bar Quick action mounting system Quick-Fix	
	- Flow control valve Standard nominal flow rate 85 l/min QS-4 connection - Vacuum generator, type H Operating pressure 1 – 8 bar Nominal operating pressure 4.5 bar Nominal diameter of laval nozzle 0.45 mm QS-4 connections Max. suction rate with respect to atmosphere 6.2 l/min Maximum vacuum 88% With silencer, plug-in Quick action mounting system Quick-Fix - Vacuum generator, type L Operating pressure 1 – 8 bar Nominal operating pressure 6 bar Nominal diameter of laval nozzle 0.45 mm QS-4 connections Max. suction rate with respect to atmosphere 15.7 l/min With silencer, plug-in Quick action mounting system Quick-Fix - Non-return valve Standard nominal flow rate 136 l/min QS-4 connection - Non-return valve, delockable	

ITEM	DESCRIPTION AND SPECIFICATION	
	As long as a pilot signal is applied to the non-return valve, compressed air flows to and from the cylinder. When the pilot signal is reset, the non-return valve shuts off the cylinder exhaust air, and cylinder motion is stopped. - Suction gripper 30 SN With suction cup holder and handle Connection QS-4 or QS-6 Diameter 30 mm Suction cup material: NBR - Suction gripper 20 SS With suction cup holder and handle	
	Connection QS-4 or QS-6 Diameter 20 mm Suction cup material: VMQ - Suction gripper 30 SS With suction cup holder and handle Connection QS-4 or QS-6 Diameter 30 mm Suction cup material: VMQ - Suction gripper 20 CS with vacuum security valve With suction cup holder and handle Connection QS-4 or QS-6 Diameter 20 mm Bellows structure, 3.5 x Suction cup material: VMQ - Suction gripper 4x20 Oval With suction cup holder and handle Connection QS-4 or QS-6 Oval suction cup design, 4 x 20 mm Suction cup material: NBR	
	- Tabletop power supply unit Input voltage: 85 – 265 V AC (47 – 63 Hz) Output voltage: 24 V DC, short-circuit-proof Output current: max. 4.5 A Dimensions: 170 x 240 x 92 mm - 4 mm Safety laboratory cables, 106 pieces, red, blue and black Complete set, consisting of 106 safety laboratory cables with 4 mm safety plugs in the colours red, blue and black: • 10x red 50 mm • 10x blue 50 mm • 8x black 50 mm • 8x red 300 mm • 8x blue 300 mm • 18x black 300 mm • 18x black 300 mm • 18x black 300 mm • 18x black 500 mm • 2x red 1000 mm • 3x blue 1000 mm • 2x black 1000 mm • 1x red 1500 mm • 1x blue 1500 mm • 1x black 1500 mm • Plugs with rigid protective sleeve and axial socket • Conductor cross section: 1 mm2 • 1000 V CAT II • Rated current: 16 A **2. Sensors for object detection (2units)** Each unit consists of the ff. Accessories/Components: Proximity sensor, magneto-resistive Magneto-resistive proximity sensor on Quick-Fix safety and quick mounting system for profile plates • 360° rotatable, detenting every 15° • Operating voltage 10 – 30 V DC • Starting function N/O contact (PNP) • Output current 200 mA	
	• Protection against short-circuit, overload and reverse polarity • Block design • Connection via the 4 mm safety connectors integrated in the Quick-Fix quick mounting system - Proximity sensor, inductive, M12 Proximity sensor with protection against polarity reversal, overload and short circuit. • M12 design • 360° rotatable, detenting every 15° • Connection via the 4 mm safety connectors integrated in the Quick-Fix® quick connector system • Power supply 10 – 30 V DC • N/O contact (PNP) starting function • Quick-Fix® quick connector system	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Sensing distance of 0 – 4 mm - Proximity sensor, inductive, M18 Inductive proximity sensor on the Quick-Fix secure and quick action mounting system for profile plates and cable with safety plug • 360° rotatable, detenting every 15° • Size M18 • Non-flush fitting • Operating voltage 15 – 34 V DC • Sensing distance 8 mm • Connection via the 4 mm safety connectors integrated in the Quick-Fix® quick mounting system • Starting function N/O (PNP) - Analog sensor, inductive, M12 Inductive distance sensor on the Quick-Fix secure and quick action mounting system for profile plates and cable with safety plug • 360° rotatable, detenting every 15° • size M12 • flush fitting • operating voltage 15 – 30 V DC • measuring range 0 – 6 mm • connection via the 4 mm safety connectors integrated in the Quick-Fix quick mounting system • analogue output, 0 – 10 V DC or 0 – 20 mA - One-way light barrier, receiver One-way light barrier receiver (optical proximity sensor) on the Quick-Fix secure and quick action mounting system for profile plates and cable with safety plug • 360° rotatable, detenting every 15° • size Q30 • operating voltage 10 – 30 V DC • light method: infrared • range up to 6,000 mm • adjustable by potentiometer • connection via the 4 mm safety connectors integrated in the Quick-Fix quick mounting system • starting function N/O (PNP) -One-way light barrier, transmitter	
	One-way light barrier, transmitter (optical proximity switch) on Quick-Fix safety and quick mounting system for profile plates and cables with safety plug. • 360° rotatable, detenting every 15° • Size Q30 • Operating voltage 10 – 30 V DC • Type of light: infrared • Range up to 6000 mm • Adjustable by potentiometer • Connection via the 4 mm safety connectors integrated in the Quick-Fix quick mounting system • Test input - Fibre-optic unit Fibre-optic unit (optical proximity switch) on Quick-Fix safety and quick mounting system for profile plates and cables with safety plug. • 360° rotatable, detenting every 15° • Size Q30 • Operating voltage 10 – 30 V DC • Type of light: red	
	• Range up to 400 mm • Adjustable by potentiometer • Connection via the 4 mm safety connectors integrated in the Quick-Fix® quick mounting system • Starting function N/O and N/C contact (PNP) - Fibre-optic cable Fibre-optic cable (through-beam sensor with polymer fibre-optic cable) on Quick-Fix safety and quick mounting system for profile plates and cables with safety plug. • 360° rotatable, detenting every 15° • Maximum range 400 mm • Minimum bending radius 25 mm • Fibre-optic cable length 2000 mm - Retro-reflective sensor Retro-reflective sensor (optical proximity switch) on Quick-Fix safety and quick mounting system for profile plates and cables with safety plug. • 360° rotatable, detenting every 15° • Size Q30 • Operating voltage 10 – 30 V DC • Type of light: red • Polarised • Range up to 2000 mm • Adjustable by potentiometer • Connection via the 4 mm safety connectors integrated in the Quick-Fix quick mounting system	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Starting function N/O contact (PNP) - Reflector (triple mirror), 20 mm Reflector on the Quick-Fix secure and quick action mounting system for profile plates • 360° rotatable, detenting every 15° • principle: triple mirror • diameter 20 mm - Diffuse sensor with background suppression	
	Diffuse sensor with background suppression (optical proximity switch) on Quick-Fix safety and quick mounting system for profile plates and cables with safety plug. • 360° rotatable, detenting every 15° • Size Q20 • Operating voltage 10 – 30 V DC • Type of light: red • Range up to 100 mm • Adjustable using teach-In • Connection via the 4 mm safety connectors integrated in the Quick-Fix quick mounting system • Starting function N/O and N/C contact (PNP) - Proximity sensor, capacitive, M12 Proximity sensor with protection against polarity reversal, overload and short circuit. • M12 design • 360° rotatable, detenting every 15° • Connection via the 4 mm safety connectors integrated in the Quick-Fix quick connector system • Power supply 10 – 36 V DC • N/O contact (PNP) starting function • Quick-Fix® quick connector system • Sensing distance of 0 – 4 mm Indicator unit and distributor, electrical	
	The device contains an acoustic indicator and four lamps with terminals and three buses for power supply. Through-contact socket pairs per lamp allow the element to also be used as a distributor. • Power consumption acoustic indicator: 0.04 W • Power consumption indicator lamps: 1.2 W Frequency acoustic indicator: 420 Hz Consisting of: Bus bar, mass flow rail, contact for 4 mm security plugs, mounting with protection against accidental contact with a built-in lock grid ledge in the fixture for electrical port and control unit or else with plug-in adaptors for the profile plate - Slide unit - Set of test objects Set of test objects for determining the response characteristics of sensors consisting of sample materials in different designs and material strength. • Magnets • Transparent and coloured plastics • Various metals • Magnets • Rubber • Cardboard • Kodak grey card • Wood • Size 50 x 50 mm • Tabletop power supply unit • Input voltage: 85 – 265 V AC (47 – 63 Hz) • Output voltage: 24 V DC, short-circuit-proof • Output current: max. 4.5 A • Dimensions: 170 x 240 x 92 mm - Workbook	
	Fifteen projects based on industrial examples, each including problem descriptions, parameters and project tasks, deal in detail with the specific subject of sensors for object detection. The main topics are configuration, function and the influence of material properties on behavior, possible applications and how to select a sensor based on the application conditions. The content topics are covered by exercises using magnetic, inductive, optical and capacitive proximity sensors. The workbook includes: • Sample solutions • Training notes • Multimedia CD-ROM with graphics, photos of industrial applications • Exercise sheets for trainees • Digital training programme, sensor technology 2: Sensors for object detection • 4 mm Safety laboratory cables, 106 pieces, red, blue and black Complete set, consisting of 106 safety laboratory cables with 4 mm safety plugs in the colours red, blue and black: • 10x red 50 mm • 10x blue 50 mm • 8x black 50 mm • 8x red 300 mm • 8x blue 300 mm	

ITEM	DESCRIPTION AND SPECIFICATION	
	• 18x black 300 mm • 8x red 500 mm • 8x blue 500 mm • 18x black 500 mm • 2x red 1000 mm • 3x blue 1000 mm • 2x black 1000 mm	
	• 1x red 1500 mm • 1x blue 1500 mm • 1x black 1500 mm • Plugs with rigid protective sleeve and axial socket • Conductor cross section: 1 mm2 • 1000 V CAT II • Rated current: 16 A	
82	**(Working Tables, Teacher & Student Chairs, Storage Cabinet, Multimedia devices) (1 lot)**	
	Working Tables (15 pcs) Working Table : (18" x 48") and standard height. Table top using 2 face laminated light gray particle board with powder coated steel framing on wheels with all four (4) lockable rollers. **Polypropylene Stacking Chair (45 pcs)** Chair seat & back: high-quality polypropylene, Chair frame: Round steel tube (heavy duty) , high quality electro-static powder coated Stacks 10 high from the floor Color: Navy blue/ dark blue **Storage Cabinet (1)** 1.20m x 1.90m Sliding Glass doors on powder-coated aluminum frame with lock 18mm laminated boards with PVC edging	
	Interactive Whiteboard (1) 78" diagonal surface, 4 pens, 1wand, wall-mount, USB Interface computer connection, Workspace software; Infrared Technology-pen & finger touch with Windows, Mac or Linux; Multi-touch with Windows 7; aspect ratio; 4:3; 8000x8000 resolution; Android & IOS tablet compatible. **Multimedia Projector (1)** USB 3LCD Projector, 2800 (or better)Lumens White and Colour Light Output , Computer Cable, USB A/USB B Cables, Remote Control, Soft Carry Case & Manual	
Civil Works (Program of Works, Detailed Cost Estimates, Drawings, etc.		
83	Laboratory Repairs Renovation *(pls see details in approved EDP)*	
Note:All MPS modules must be official equipment for WorldSkills Mechatronics. *All packages should come with complete training program, laboratory manuals/workbooks and* *Training Details:* *A. Pre-delivery training (at Supplier's Venue) for:* *One (1) potential expert in Mechatronics* *One(1) in-charge of Mechatronics curriculum* *Duration: 7 days* *Expenses relative to training (transportation and accommodation) will be shouldered by the* *B. After delivery - trainlng to be conducted at MUST.* *No limit of the number of participants.* *Duration of training: 6 days during the contract period.*		
11.2 Automation, Instrumentation and Process Control		
84	**Basic Pneumatic Package**	
	3/2-way valve with pushbutton actuator, normally closed (2pcs) 3/2-way valve with pushbutton actuator, normally open 5/2-way valve with selector switch 3/2-way valve with selector switch, normally closed 3/2-way roller lever valve, normally closed (2pcs) Proximity switch, pneumatic, with cylinder attachment (2pcs) Pneumatic timer, normally closed Pressure sequence valve 3/2-way pneumatic valve, pneumatically actuated, one side 5/2-way valve, pneumatically actuated, one side 5/2-way double pilot valve, pneumatically actuated, both sides (3pcs)	
	Shuttle valve (OR) Dual-pressure valve (AND) (2pcs) Quick-exhaust valve One-way flow control valve (2pcs) Single-acting cylinder Double-acting cylinder Start-up valve with filter control valve Pressure regulator valve with Pressure gauge (2pcs) Manifold Plastic tubing 4 x 0.75 Silver 10 m	

ITEM	DESCRIPTION AND SPECIFICATION	
	Silent type Compressor Oil-lubricated, Extremely quiet (45 dB (A)) compressor. With pressure regulator and water separator.Pressure: 800 kPa (8 bar) Pmax, Performance: 50 l/min, Reservoir capacity: 24 l, Compressed air outlet: ¼" or KD4, Noise level: 45 dB (A)/1 m, Duty cycle: max. 50 %, Pressure regulator valve with gauge, Design: 230 V/50 Hz	
	1 roll, pneumatic hose, 3 mm dia	
85	**Basic Electro-Pneumatics with Aluminum Profile**	
	Composition: 1.Signal input, electric (1) (Contact set: 1 makes, 1 breaks) Contact load: Maximum 2 A, Power consumption (Miniature bulb): 0.48 W Consisting of: 3 illuminated push buttons, illuminated pressure, switch,each with a mini bulb, bus bar, mass flow rail, 1 N/O, contacts and 1 NC contacts for 4 mm security plugs, Mounting with protection against accidental contact with a built-in lock grid ledge in the fixture for electrical port and control unit or else with plug-in adaptors for the profile plate.) 2. Relay, Three fold (2) (Contact set: 1 makes, 1 breaks Contact load: Maximum 2 A, Power consumption (Miniature bulb): 0.48 W Consisting of: 3 illuminated push buttons, 1 illuminated pressure switch,each with a mini bulb, bus bar, mass flow rail, 1 N/O contacts and 1 NC contacts for 4 mm security plugs. Mounting with protection against accidental contact with a built-in lock grid ledge in the fixture for electrical port and control unit or else with plug-in adaptors for the profile plate. 3.Limit switch, electrical, left-actuated (1) -The micro switch can be wired as a N/O contact, N/C contact or a changeover switch, using the 4 mm safety sockets integrated in the quick action mounting system Quick-Fix. Possible contact load: maximum 5 A 4.Limit switch, electrical, right-actuated (1) - The micro switch can be wired as a N/O contact, N/C contact or a changeover switch, using the 4 mm safety sockets integrated in the quick action mounting system Quick-Fix. Possible contact load: maximum 5 A 5.Proximity sensor, optical, M12 (1) - Proximity sensor with protection against polarity reversal, overload and short circuit. • M12 design • 360° rotatable, detenting every 15° • Connection via the 4 mm safety connectors integrated in the Quick-Fix quick connector system • Power supply 10 – 30 V DC • N/O contact (PNP) starting function • Quick-Fix quick connector system • Adjustable sensing distance of 70 – 300 mm, with LED 6.Electronic proximity sensor with cylinder attachment (2) - Magneto-resistive proximity sensor, magnetically operated • Connection via 4 mm safety sockets	
	• Switching output N/O contact (PNP) with switching status indication • Overload and short-circuit proof, with reverse polarity protection • Operating voltage 5 – 30 V DC • Output current: max. 100 mA • Switching time (on/off) max. 1 ms • Mounting system for cylinder diameter 20 mm, 2x T-slot for simultaneous mounting of one pneumatic and one electronic proximity sensor	
	7. 2 x 3/2-way solenoid valve with LED, normally closed (1) - Pilot actuated, single solenoid piston spool valve with pneumatic spring return, non-detenting and detenting manual override, and LED. • Electrical connection via integrated 4 mm safety sockets • 24 V DC power supply • Switching time on/off 6/16 ms • Pneumatic connection via QS-4 push-in fitting • Operating pressure 150 – 800 kPa (1.5 – 8 bar) • Quick-Fix® safety and quick action mounting system for slotted profile plates 8.5/2-way solenoid valve with LED (2) -Pilot actuated, single solenoid piston spool valve with pneumatic spring return, non-detenting and detenting manual override, and LED. • Electrical connection via integrated 4 mm safety sockets • 24 V DC power supply • Switching time on/off 7/19 ms • Pneumatic connection via QS-4 push-in fitting • Operating pressure 250 – 800 kPa (2.5 – 8 bar) • Quick-Fix® safety and quick action mounting system for slotted profile plates 9.5/2-way double solenoid valve with LED (1) - Pilot actuated, double solenoid piston spool valve with non-detenting and detenting manual override, and LED. • Electrical connection via integrated 4 mm safety sockets • 24 V DC power supply • Response time 7 ms • Pneumatic connection via QS-4 push-in fitting • Operating pressure 150 – 800 kPa (1.5 – 8 bar)	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Quick-Fix® safety and quick action mounting system for slotted profile plates 10.Pressure sensor with display (1) - Piezoresistive relative pressure sensor with LCD display, freely programmable switching function, adjustable hysteresis and analogue output for direct measured data acquisition. • 360° rotatable, detenting every 15° • Connection via the 4 mm safety connectors integrated in the Quick-Fix® quick connector system • Power supply 15 – 30 V DC • Switching output PNP • Analogue output 0 – 10 V DC • Pneumatic connection via QS-4 push-in fitting • Pressure measuring range 0 – 1000 kPa (0 – 10 bar) • Quick-Fix® safety and quick connector system for slotted profile plates 11. One-way flow control valve (4) - • Design: One-way flow control valve	
	• Pressure range: 20 – 1000 kPa (0.2 – 10 bar) • Nominal flow rate in flow control direction: 0 – 85 l/min in open direction: 100 – 110 l/min 12. Single-acting cylinder (1) - Single-acting cylinder with control cams. • Design: Piston cylinder • Operating pressure: Maximum 1000 kPa (10 bar) • Stroke length: Maximum 50 mm	
	• Thrust at 600 kPa (6 bar): 150 N • Spring return force minimal: 13.5 N 13. Double-acting cylinder (2) - Double-acting cylinder with control cams. End-position cushioning with two adjusting screws. A permanent magnet is mounted on the cylinder piston. Its magnetic field can trigger a proximity switch. • Design: Piston cylinder • Operating pressure: Maximum 1000 kPa (10 bar) • Stroke length: Maximum 100 mm • Thrust at 600 kPa (6 bar): 165 N • Return thrust at 600 kPa (6 bar): 140 N 14. Start-up valve with filter control valve(1) - Filter control valve with Pressure gauge and Start-up valve mounted on adapter with ajustable angle. The Start-up valve pressures/exhausts the connected pressure zone. • Design: sintered filter with water separator and piston regulator • Standard flow: 120 l/min • Pressure regulation range: 50-700 kPa (0,5-7 bar) • Grade of filtration: 40 µm • Fitting: G 1/8, QS-6, for Plastic tubing PUN 6 x 1 15. Manifold (1) - Manifold with eight self-closing non-return valves. A common manifold (QS-6 for plastic tubing PUN 6 x 1) allows supply of compressed air to the control via eight individual ports (QS-4 for plastic tubing PUN 4 x 0.75). • Connector: G 1/8 16. Plastic tubing, 4 x 0.75 silver 10 m (1) - Very flexible and pressure secure. PUN 4 x 0.75,Silver • Exterior diameter: 4 mm PUN 6 x 1,Silver • Exterior diameter: 6 mm • Interior diameter: 4 mm 17. 4 mm Safety laboratory cables (1) - • 10x red 50 mm • 10x blue 50 mm • 26x red 300 mm • 11x blue 300 mm • 21x red 500 mm • 12x blue 500 mm • 3x red 1000 mm • 3x blue 1000 mm • 1x red 1500 mm • 1x blue 1500 mm • Plugs with rigid protective sleeve and axial socket • Conductor cross section: 1 mm2 • 1000 V CAT II • Rated current: 16 A 18. Power supply (1) - • Input voltage: 85 – 265 V AC (47 – 63 Hz) • Output voltage: 24 V DC, short-circuit-proof • Output current: max. 4.5 A • Dimensions: 170 x 240 x 92 mm	
	19.Preset counter, electronic (1) - Electronic preset counter with terminals for count pulse, contact set and reset pulse, as well as bus bars for supply power. • Contact set: 1 changeover contact • Contact rating: max. 5 A • Power consumption: 3 W • Maximum counting rate: 30 Hz	
	• Preset value display: 4-place, red (counter reading) and yellow (preselection) illuminated • Preset value programmable at each digit with up/down keys • Reset key for manual resetting	
	• Lock key for locking the preset value Consisting of: • Electronic counter with EEPROM for retaining the preset value and the current counter value in case of power failure	

ITEM	DESCRIPTION AND SPECIFICATION	
	• 4-place preset value display • Electronic or manual reset • One changeover contact • Supply contact rail • Earth contact rail • Connection for 4 mm safety plug • Attachment via protection against accidental contact with integrated locking strip in the mounting frame for electrical connection and control units or via plug adapter on the slotted assembly board 20.Time relay, two-fold (1) - The element contains a release-delay and a pickup-delay time relay. Both relays are infinitely variable, using the rotary knob of the potentiometer. • Contact set: 2 makes, 2 breaks • Contact load: Maximum 5 A • Cut-off load: Maximum 100 W • Delay: 0.5 – 10 s adjustable Consisting of: 1 relay for switch-on delay, 1 relay for switch-off delay, 2 normally open contacts and 2 normally closed contacts per relay, connection for 4 mm safety plug mounting via contact protection with integrated locking strip in the mounting frame for electrical terminal and control units or via plug-in adapter on slotted profile plate, supply contact rail, earth contact rail. 21.Systainer/Container with components trays (1) - Stackable and interlocking case system, made of light grey plastic with light blue T-LOC rotary locks, one-hand operation, for opening and interlocking the Systainers®. With four slots for credit-card-sized labels or markings. TEACHWARE: 1. Workbook: (1) Twelve project-orientated exercises, increasing in complexity and suitable for equipment set TP 201, are the ideal introduction to electropneumatics. Real problem descriptions with positional sketch, concrete project tasks and detailed aids for professional implementation provide the ideal preparation for ta real-life industrial environment. The workbook includes: • Sample solutions • Training notes • Multimedia CD-ROM with graphics, photos of industrial applications, animations and circuit diagrams • Exercise sheets for trainees	
	2.Pneumatics and Electro-Pneumatics, Simulation software (1) 3.WBT (web-based training)Electropneumatics (1) 4.Textbook Basic principles of pneumatics and electropneumatics (1) 5.DVD Electropneumatics (1) 6.Easy port USB for and interface for measuring, open-loop control, closed loop control (Simulation between hardware and software without using PLC) (1)	
86	**Basic Electro-hydraulic Trainer with Aluminum Profile, power pack and Accesories**	
	Components: 1. Pressure relief valve - The valve limits the pressure at port P relative to the pressure at T to the set value. • Adjustment: manual • Includes non-return valve • Operating pressure 6 MPa (60 bar) • Maximum permissible pressure 12 MPa (120 bar) • Low-leakage, self-sealing coupling nipples • Quick action mounting system Quick-Fix 2. 2-way flow control valve - The valve ensures a constant volumetric flow rate in the flow direction from A to B, regardless of the load pressure on B. The oil can flow from B to A via the non-return valve which opens. • Actuation: manual • Differential pressure of the pressure balance 0.55 MPa (5.5 bar) • Operating pressure 6 MPa (60 bar) • Maximum permissible pressure 12 MPa (120 bar) • Low-leakage, self-sealing coupling nipples • Quick action mounting system Quick-Fix 3. One-way flow control valve - The valve is used to influence the volumetric flow rate through an adjustable throttle point, in one direction. In the opposite direction, the throttle is bypassed using the non-return valve. • Actuation: manual • Integrated non-return valve • Operating pressure 6 MPa (60 bar) • Maximum permissible pressure 12 MPa (120 bar)	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Low-leakage, self-sealing coupling nipples/quick coupling socket	
	4. • Non-return valve - The valve is closed by a locking cone which is pressed against the seat by a spring. When the opening pressure on the seat side is exceeded, the valve opens and fluid can flow through it. When the pressure on the spring side is greater, the valve remains closed.	
	• Actuation: hydraulic	
	• Tube length 1000 mm	
	• Operating pressure 6 MPa (60 bar)	
	• Maximum permissible pressure 12 MPa (120 bar)	
	• Low-leakage, self-sealing quick coupling sockets	
	• 4/2-way solenoid valve, spring return	
	• Actuation: switching solenoid	
	• Operating pressure 6 MPa (60 bar)	
	• Maximum permissible pressure 12 MPa (120 bar)	
	• Valve port pattern, hydraulic ISO/DIN 4401 size 02	
	• Low-leakage, self-sealing coupling nipples	
	• 24 V DC power	
	• 6.5 W output	
	• Electrical connection: 4 mm safety socket	
	• Quick action mounting system Quick-Fix	
	5. • 4/3-way solenoid valve, closed mid-position	
	• Actuation: switching solenoid	
	• Operating pressure 6 MPa (60 bar)	
	• Maximum permissible pressure 12 MPa (120 bar)	
	• Valve port pattern, hydraulic ISO/DIN 4401 size 02	
	• Low-leakage, self-sealing coupling nipples	
	• 24 V DC power	
	• 6.5 W output	
	• Electrical connection: 4 mm safety socket	
	• Quick action mounting system Quick-Fix	
	6. 4/2-way double solenoid valve, detenting	
	• Actuation: switching solenoid	
	• Operating pressure 6 MPa (60 bar)	
	• Maximum permissible pressure 12 MPa (120 bar)	
	• Valve port pattern, hydraulic ISO/DIN 4401 size 02	
	• Low-leakage, self-sealing coupling nipples	
	• 24 V DC power	
	• 6.5 W output	
	• Electrical connection: 4 mm safety socket	
	• Quick action mounting system Quick-Fix	
	7. Shut-off valve - The valve can be closed by turning the lever. This presses a ball onto the seal on the non-pressurized side, sealing off the flow without any leakage.	
	• Actuation: manual	
	• Operating pressure 6 MPa (60 bar)	
	• Maximum permissible pressure 12 MPa (120 bar)	
	• Low-leakage, self-sealing coupling nipples/quick coupling socket	
	8. Weight, 9 kg, for cylinder - Weight for mounting on a Leamline profile column. Can be used as the driving or tractive load of a hydraulic cylinder. With clevis and plain-bearing guide.	
	9. Differential cylinder 16/10/200 with cover	
	• Operating pressure 6 MPa (60 bar)	
	• Maximum permissible pressure 12 MPa (120 bar)	
	• Double-acting	
	• Low-leakage, self-sealing coupling nipples	
	• Quick action mounting system Quick-Fix	
	• Piston Ø: 16 mm	
	• Piston rod Ø: 10 mm	
	• Stroke: 200 mm	
	• Surface area ratio 1 : 1.6	
	10. Mounting kit for cylinders - Fitting a mounting kit on a cylinder makes the following possible:	
	• Actuation of the stem actuated valve by the guide bar	
	• Actuation of proximity sensors by the permanent magnet of the guide bar	
	• Use of a displacement encoder	
	• Mounting kit for cylinders	
	Suitable for cylinders	

ITEM	DESCRIPTION AND SPECIFICATION	
	11. T-distributor - The distributor can be inserted at any point. • Ports: 2x coupling nipples and 1x quick coupling socket	
	• Maximum permissible pressure 12 MPa (120 bar) • Low-leakage, self-sealing coupling 12. 4-way distributor with pressure gauge Commissioning All quick connection couplings are connected via holes in the distributor block. The coupling nipple on the side can be swapped with the blanking plug on the opposite side. The pressure in the distributor can be read off on the pressure gauge. 13. Pressure gauge -The pressure gauge can be inserted at any point for pressure measurement. • Effective range and maximum permissible pressure 10 MPa (100 bar) • Quality class 1.6% of the full scale value • Operating pressure, static: 3/4 of full scale value • Operating pressure, dynamic: 2/3 of full scale value • Cushioning: glycerine • Low-leakage, self-sealing couplings 14. Pressure switch, electronic -The pressure switch can be inserted at any point for pressure measurement and has two switching outputs and an analogue output. • Operating voltage 18 – 35 V DC • Switching outputs 2 x PNP, maximum 1.2 A • Effective range and maximum permissible pressure 10 MPa (100 bar) • Analogue output 0 – 10 V • 4-digit digital display, can be rotated along 2 axes • Electrical connection M12, 5-pin on 4 mm safety plug • Low-leakage, self-sealing couplings 15. Relay, three-fold - The device has three relays with terminals and two buses for power supply. • Contact load: max. 5 A • Cut-off load: max. 90 W • Pick-up time: 10 ms • Drop-off time: 8 ms Consisting of: 4 changeover switches, electricity supply rail, mass flow rail, ports for 4 mm safety plugs. Mounting with protection against accidental contact with a built-in lock grid ledge in the fixture for electrical port and control unit or else with plug-in adaptors for the profile plate. 16.Signal input, electrical -The device contains an illuminated pushbutton switch (control switch) and three illuminated pushbuttons (momentary contact switches) with terminals and two buses for power supply. • Contact set: 1 makes, 1 breaks • Contact load: Maximum 2 A • Power consumption (Miniature bulb): 0.48 W	
	Consisting of: 3 illuminated push buttons, 1 illuminated pressure switch, each with a mini bulb, bus bar, mass flow rail, 1 N/O contacts and 1 NC contacts for 4 mm security plugs. Mounting with protection against accidental contact with a built-in lock grid ledge in the fixture for electrical port and control unit or else with plug-in adaptors for the profile plate.	
	17. Limit switch, electrical, left-actuated -The micro switch is actuated mechanically when the roller lever is pressed, for example by the trip cam of a cylinder. The micro switch can be wired as a N/O contact, N/C contact or a changeover switch, using the 4 mm safety sockets integrated in the quick action mounting system Quick-Fix®. Possible contact load: maximum 5 A • Limit switch, electrical, right-actuated The micro switch is actuated mechanically when the roller lever is pressed, for example by the trip cam of a cylinder. The micro switch can be wired as a N/O contact, N/C contact or a changeover switch, using the 4 mm safety sockets integrated in the quick action mounting system • Possible contact load: maximum 5 A 18. Proximity sensor, electronic - Magneto-resistive proximity sensor, magnetically operated • Connection via 4 mm safety connectors • Switching output N/O contact (PNP) with switching status indication • Overload and short-circuit proof, with reverse polarity protection • Operating voltage 5 – 30 V DC • Output current: max. 100 mA • Switching time (on/off) max. 1 ms • Mounting system for T-slot 19. Hose line with quick release couplings - The high-pressure hose consists of three layers: The innermost layer is synthetic rubber, followed by a wire mesh and sheath of abrasion-resistant synthetic rubber. The quick coupling sockets are self-sealing when decoupled. Used with a coupling nipple, the coupling sockets form a tightly sealed connection. Only the face of the coupling is coated with oil during the coupling process. Coupling and decoupling are only permissible when the hose is de-pressurised.	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Operating pressure 6 MPa (60 bar) • Max. permissible pressure 12 MPa (120 bar) • Temperature range -40 – + 125 °C • Min. bending radius 100 mm • DN 06 (Ø 6,3 mm) 20. 4 mm Safety laboratory cables, 106 pieces, red, blue and black Complete set, consisting of 106 safety laboratory cables with 4 mm safety plugs in the colours red, blue and black: • 10x red 50 mm • 10x blue 50 mm • 8x black 50 mm • 8x red 300 mm • 8x blue 300 mm • 18x black 300 mm • 8x red 500 mm • 8x blue 500 mm • 18x black 500 mm • 2x red 1000 mm • 3x blue 1000 mm • 2x black 1000 mm • 1x red 1500 mm • 1x blue 1500 mm, 1x black 1500 mm • Plugs with rigid protective sleeve and axial socket • Conductor cross section: 1 mm2 • 1000 V CAT II • Rated current: 16 A	
	21. Laboratory Workstation with Aluminium profile plate 700x1100mm and ER frame -The anodised aluminium profile plate forms the basis for all training packages. All of the components fit securely and safely into the grooves on the profile plate. There are grooves on each side and, if required, both sides can be fitted with components. The grooves are compatible with the ITEM profile system. Grid dimensions: 50 mm. Sizes 350 x 1100 mm and 350 x 250 mm supplied without side caps (H x W). 22. Hydraulic power pack with a constant-displacement pump, 230 V - Ideal for individual hydraulic workstations for all experiments using standard equipment sets TP 500,	
	600 and the MPS® punching station. • Mounting on Learnline with universal bracket • Mounting on Learntop-S: direct • Pump design: external gear motor with pressure relief valve adjustable from 0 – 6 MPa (0 – 60 bar) • Operating pressure 6 MPa (60 bar) • Motor: AC, single-phase with overload protection, start capacitor and ON/OFF switch • Tank: 5 l volume, sight glass, temperature display, drain screw • Air filter and return filter • Low-leakage, self-sealing coupling nipples for P and T • Plug socket for unpressurised return • Connecting flange for measuring container return • Dimensions: 580 x 300 x 180 mm (W x D x H) • Weight: 19 kg • Nominal voltage: 230 V AC • Rated output: 0.65 kW • Frequency: 50 to 60 Hz • Delivery rate (rated speed): 2.2 – 2.7 l/min at 1320 – 1680 m-1 • Protective cover for weight, 9 kg • Tabletop power supply unit • Power supply unit for mounting frame • Hydraulics Simulation software, license • Electrohydraulics: WBT	
87	**Closed-loop Pneumatic Trainer/ Advanced Electro-Pneumatics, Equipment Set**	
	Accessories/Components: 1. Signal input, electrical 2. 3/2-way valve with pushbutton actuator, normally closed - Pilot actuated, single solenoid piston spool valve with pneumatic spring return, non-detenting and detenting manual override, and LED. • Electrical connection via integrated 4 mm safety sockets • 24 V DC power supply • Switching time on/off 6/16 ms • Pneumatic connection via QS-4 push-in fitting • Operating pressure 150 – 800 kPa (1.5 – 8 bar) • Quick-Fix® safety and quick action mounting system for slotted profile plates 3. 2 x 3/2-way solenoid valve with LED, normally closed -	
	Pilot actuated, single solenoid piston spool valve with pneumatic spring return, non-detenting and detenting manual override, and LED. • Electrical connection via integrated 4 mm safety sockets	

ITEM	DESCRIPTION AND SPECIFICATION	
	• 24 V DC power supply	
	• Switching time on/off 6/16 ms • Pneumatic connection via QS-4 push-in fitting • Operating pressure 150 – 800 kPa (1.5 – 8 bar) • Quick-Fix® safety and quick action mounting system for slotted profile plates Pressure gauge - The pressure gauge shows the pressure in pneumatic control circuits. • Design: Bourdon tube pressure gauge • Display range: 0 – 1000 kPa (0 – 10 bar) • Quality class: 1.6 4. One-way flow control valve 5. On-off valve with filter/regulator, 5 µm - Filter regulator valve with pressure gauge, on-off valve, quick push-in connectors and quick coupling plug, mounted on a swivel support. The filter with water separator removes dirt, pipe sinter, rust and condensed water. The pressure regulator maintains the supply air pressure at the set operating pressure and compensates pressure fluctuations. The filter bowl has a condensate drain valve. The on-off valve pressurises and vents the entire control system. The 3/2-way valve is actuated by a rotary button. • Design: Piston regulator valve with sintered filter and water trap • Standard nominal flow rate*: 1600 l/min • Input pressure: max. 1600 kPa (16 bar) • Working pressure: max. 1200 kPa (12 bar) • Grade of filtration: 5 µm • Condensate quantity: 43 cm3 • Connector: G 1/8, QS-6 for plastic tubing PUN 6 x 1 * Input pressure: 1000 kPa (10 bar) Operating pressure: 600 kPa (6 bar) Differential pressure: 100 kPa (1 bar) 6. Manifold - Manifold with eight self-closing non-return valves. A common manifold (QS-6 for plastic tubing PUN 6 x 1) allows supply of compressed air to the control via eight individual ports (QS-4 for plastic tubing PUN 4 x 0.75). • Connector: G 1/8 7. Plastic tubing - Very flexible and pressure secure. PUN 4 x 0.75 • Exterior diameter: 4 mm • Interior diameter: 2.6 mm PUN 3 x 0.5 • Exterior diameter: 3 mm • Interior diameter: 2.1 mm PUN 6 x 1 • Exterior diameter: 6 mm • Interior diameter: 4 mm	
	8. PID controller - PID controller for pneumatic and hydraulic control circuits.	
	Consisting of: Bus bar, mass flow rail, contact for 4 mm security plugs, mounting with protection against accidental contact with a built-in lock grid ledge in the fixture for electrical port and control unit or else with plug-in adaptors for the profile plate. The controller comprises the following: • Voltage supply • Differential inputs • Comparators • Final control elements: positional control elements, speed control elements, acceleration controlelements (status controller), proportional control elements, integralcontrol elements, differential control elements (PID controller) • Overall gain (Status controller) • Correcting variable offset • Summing junction • Limiter • Output Technical data: • Overmodulation indicator: -10 > Ue > +10 V • Input voltage range: -13 – +13 V • Output voltage limitation: [0 – +10 V] [-10 – +10 V] • Correcting variable offset: 5 ±3.5 V at [0 – +10 V] 0 ±7 V at [-10 – +10 V] • Proportional coefficient KP: 0 – 1000 • Integral coefficient KI: 0 – 1000 s-1	

ITEM	DESCRIPTION AND SPECIFICATION	
	9. Comparator - Positive switching comparator with hysteresis. The inputs are short-circuit-proof or surge-proof to 24 V. 2 separate inputs (IN A, IN B) each acting on two independent comparators. Each comparator can be set to: • Reference voltage (-10 – +10 V), Hysteresis (0 – +5 V). • Input voltage (inputs A and B): -10 – +10 V • Input resistance (inputs A and B): > 10 kΩ • Display accuracy: ± 30 mV • Outputs A and B: Floating relay contacts, changeover contacts • Contact load: 24 V DC/2 A and 120 V AC/1 A Consisting of: Bus bar, mass flow rail, contact for 4 mm security plugs, mounting with protection against accidental contact with a built-in lock grid ledge in the fixture for electrical port and control unit or else with plug-in adaptors for the profile plate. 10. Pressure sensor, analog • Pressure measuring range*: 0 – 1000 kPa (0 – 10 bar) • Maximum permissible pressure: 1400 kPa (14 bar) • Power supply: 12 – 30 V DC • Output signals: Voltage output 0 – 10 V • Frequency, maximum: 100 Hz • Electrical protection: Short-circuit proof, polarity reversal protected *The sensor will also supply a signal at pressures of < 0 bar. Linearity and proportionality cannot be guaranteed in this case. 11. 5/3-way solenoid valve, mid position closed - Pilot actuated, spring centred piston spool valve with non-detenting and detenting manual override, and LED.	
	• Electrical connection via integrated 4 mm safety sockets • 24 V DC power supply • Switching time on/off/changeover 10/30/16 ms • Pneumatic connection via QS-4 push-in fitting • Operating pressure 300 – 800 kPa (3 – 8 bar) • Quick-Fix® safety and quick action mounting system for slotted profile plates • 5/3-way proportional valve - The integrated electronic control of the slide path allows favorable static and dynamic characteristics, as reflected by low hysteresis (<0.3 %), short switching time (typically 5 ms) and higher upper critical frequency (approx. 100 Hz). For this reason the valve is particularly suitable as an actuator for position control of a pneumatic cylinder, particularly in conjunction with a higher-level position controller. 5/3-way proportional valve mid position closed actuated on both sides spring centered, manual override mounting system • Medium: Compressed air, microfiltered (unlubricated) • Pressure range: 600 – 1000 kPa (6 – 10 bar) • Flow rate at nominal pressure: Maximum 700 l/min • Power consumption: 2 – 20 W • Analog setpoint voltage: 0 – 10 V DC • Nominal value at pneumatic mid-position: 5 V DC • Duty cycle in accordance with VDE 0580: 100 % 12. Air pressure reservoir, 0.4 l - Air pressure reservoir for generating static pressure with the aid of a one-way flow control valve, for the generation of long time delays in conjunction with time-delay and flow control valves, for compensation of pressure fluctuations, as reservoir for sudden pressure drop, and for generation of a control system with a delay of the 1st order. • Design: Brazed tank • Capacity: 400 ml • Pressure range: 0 – 1600 kPa (0 – 16 bar) 13. Status controller - The status controller is used as a regulator in pneumatic and hydraulic position control circuits. Consisting of: Bus bar, mass flow rail, contact for 4 mm security plugs, mounting with protection against accidental contact with a built-in lock grid ledge in the fixture for electrical port and control unit or else with plug-in adaptors for the profile plate. The controller comprises the following: • Voltage supply• Differential inputs • Comparators • Final control elements: positional control elements, speed control elements, acceleration controlelements (status controller), proportional control elements, integralcontrol elements, differential control elements (PID controller) • Overall gain (Status controller) • Correcting variable offset • Summing junction • Limiter • Output Technical Data: • Overmodulation indicator: -10 > Ue > +10 V • Input voltage range: -13 – +13 V • Output voltage limitation: [0 – +10 V] [-10 – +10 V] • Correcting variable offset: 5 ±3.5 V at [0 – +10 V] 0 ±7 V at [-10 – +10 V] • Position coefficient Kx: – 10	
	• Speed coefficient Kx: 0 – 100 ms • Acceleration coefficient Kx: 0 – 10 s2 • Overall gain P: 0 – 1000	

ITEM	DESCRIPTION AND SPECIFICATION	
	14. Status controller - The status controller is used as a regulator in pneumatic and hydraulic position control circuits. Consisting of: Bus bar, mass flow rail, contact for 4 mm security plugs, mounting with protection against accidental contact with a built-in lock grid ledge in the fixture for electrical port and control unit or else with plug-in adaptors for the profile plate. The controller comprises the following: • Voltage supply • Differential inputs • Comparators	
	• Final control elements: positional control elements, speed control elements, acceleration controlelements (status controller), proportional control elements, integralcontrol elements, differential control elements (PID controller) • Overall gain (Status controller) • Correcting variable offset • Summing junction • Limited • Output Technical Data: • Overmodulation indicator: -10 > Ue > +10 V • Input voltage range: -13 – +13 V • Output voltage limitation: [0 – +10 V] [-10 – +10 V] • Correcting variable offset: 5 ±3.5 V at [0 – +10 V] 0 ±7 V at [-10 – +10 V] • Position coefficient Kx: – 10 • Speed coefficient Kx: 0 – 100 ms • Acceleration coefficient Kx: 0 – 10 s2 • Overall gain P: 0 – 1000 15. Linear drive, pneumatic, with guide and accessories - For proximity sensing, with positive-locking between piston and carrier, and adjustable end-position cushioning. • Space-saving rodless linear drive. • Double-acting cylinder; compressedair for forward and return strokes. • Power application point is protectedagainst rotation around the longitudinal axis. • Adjustable end-position cushioning inboth end positions. • Permanent magnet mounted on piston toallow position sensing by a suitable proximity switch. This allows proximitysensing of end positions and intermediate positions. • More compact than conventionalcylinders through rodless design. • Type of damping: Pneumatic, adjustable • Buffering length: 18 mm • Rotation protection: Guide • Stroke length: 450 mm • Overall length: 650 mm • Pressure range: 200 – 800 kPa (2 – 8 bar) • Type of port/diameter: Thread G 1/8 " • Usable power (theoretical) at 600 kPa (6 bar): 295 N • Air consumption at 6 bar: 0.03 l/ stroke Including connection and mounting material	
	16. Position encoder - Analog displacement encoder for pneumatic linear drive unit for determining the current actual position. When ordering single units, please also order mounting accessories The connection cable is required for use in TP 111. • Measuring stroke: 450 mm • Mass: 1.2 kg • Output signal at cable output of Connection cable (Order no. 376177): 0 – 10 V	
	17. Ruler - Ruler, with millimeter scale printed on both sides, with two knurled screws. Used to measure position of the guides of the linear drive (Order no. 192501). • Total length: 500 mm • Scale length: 450 mm • Unit of measurement: mm 18. Weight, 5 kg, for linear drive - Weight for mounting on a linear drive to be used as additional load. Self-setting hydraulic shock absorber for smooth deceleration. Suitable for the pneumatic linear drives When ordering separately, please also order shock-absorber bracket • Stroke:12 mm • Impact speed: Maximum 3 m/s • Connecting cable for linear potentiometer • Adapter for Y-axis or weight • Adapter for mounting the applied load on the pneumatic linear drive unit. • Mounting accessories for position encoder	
88	**16 Digital/Analogue Inputs/Outputs Compact PLC Educational Trainer**	
	Technical Data for the CPU: • Supply power: 24 V DC • Maximum input power: 40 VA Inputs/outputs: • Input current, IN 0 – 3: 7.3 mA, 0 – 20 kHz at 24 V • Input current, IN 4 – 16: 8.9 mA, 0 – 1 kHz at 24 V • 8 relay outputs: 1.2 A at 24 V DC • 8 FET outputs: 1 A The mounting system: • 19" module with SysLink system connector. • Suitable for ER mounting frame or unfastened on the table	

ITEM	DESCRIPTION AND SPECIFICATION	
	• Lightweight injection moulded housing • The unit is supplied fully assembled. • Other combinations are possible via the online configurator. Recommended training media: Digital training programme training in PLC programming in accordance with IEC 61131. Contents: • Programmable logic controllers • Project organisation • Programming languages in accordance with IEC 61131 • Link-orientated programming languages • Sequential function chart • Structured text • Sequence programming project • The training program provides beginners with an ideal introduction to IEC-compliant programming.	
	• In addition to trainees, pupils and students, it also appeals to skilled workers, technicians and engineers who have previously only programmed in IL, LDR or FCH. The higher, IEC-compliant languages provide a range of benefits to be discovered and used. Accessories: • I/O data cable with connectors (IEEE 488) at both ends, 2.5 m • Universal connection unit, digital. • Programming cable • Programming software • Workbook	
89	**Instrumentation and Process Control Compact Workstation**	
	The Compact Workstation Energy is equipped with current and power meters, and includes the measuring and training monitoring software Energy. **Power supply unit:** Input voltage: 85 – 265 V AC (47 – 63 Hz) Output voltage: 24 V DC, short-circuit-proof Output current: max. 4.5 A **Monitoring/Visualization software:** Operation, open- and closed-loop control with the Easy Port communication module (Interfacing unit between the computer to Process Control or PLC to Hardware or software to software Visualization) Control-technology operations and continuous and discontinuous controllers are presented. Subsequent analyses bring a valuable, basic realization, which can be transferred to the general technology. Especially general training aims, such as the concentrated observation and analysis of systems. Virtual PLC – actuating with simulation using the basics of PLC programming and the logical processing of binary and analogue signals. Test the program on a virtual or real model. Filling with Excel Transmitted order data from MS Excel via the DDE interface, e.g. the number and volume of the bottles. Conversely, the current status of the plant, for example the level of the storage tanks, is reported. MPS PA Compact Workstation: Workbook Process automation: Web based training, License Open- and closed-loop control: Web based training, License Easy port USB interface for measuring, Open-loop control, Closed loop control Mechanical Components: Two (2) Transparent Reservoirs, Air Pressure Reservoir with Pressure Gauge, Plug-in tubing system Mounting Frame for Electrical Devices and Controls Aluminium Profile Plate on a Portable Trolley **Sensors:** Two (2) Capacitive Sensors Two (2) Mechanical Contact Float Switches Ultrasonic Level Transmitter 345 mm Range Opto-electronic Vane Flow Transmitter 0-7.5l/min Range Piezoelectric Ceramic Pressure Sensor 0-0.4 bar Range PT100 Temperature Transmitter 0-100 deg. C Range	
	Actuators: Centrifugal Pump 0-10 V Control Voltage Proportional Solenoid Process Valve 0-10V Control Voltage Process Ball Valve with On/Off Pneumatic Quarter-Turn Actuator Heater, 1 KW	
	Electrical Components: Signal Converters or Transducers: I/V, f/V, R/V	

ITEM	DESCRIPTION AND SPECIFICATION	
	Motor Controller and Current Limiter for Centrifugal Pump's Motor Digital and Analogue I/O terminal strip: 8DI/8O and 4AI/2AO Syslink Plug Connection of Digital and Analogue I/O to Controllers such as PC or PLC Signal conversion with parameterisable measured-value transducers, includes parameterization software and programming cable **Controller:** **Programmable Logic Controller** 16 Digital Inputs + 16 Digital Outputs 4 Analogue Inputs (4-20 mA, 0-10V, RTD) + 2 Analogue Outputs (4-20 mA and 0-10V) 24 Vdc Power Ethernet Interface for Fieldbus, HMI and Programming Connections CANOpen fieldbus interface 2 Digital I/O Syslink Cable 1 Analogue I/O Syslink Cable 1 Ethernet Cable, Crossed PLC Development Software Built-in Software Simulator or Virtual PLC with Runtime and Graphics **Monitoring/Visualization Software Controller in a PC** Measuring and Control (with Real-Time Graph and Measurement Data) Charateristic Curves of Sensors and Actuators Closed Loop Control of Level, Flow, Pressure and Temperature using PID Continuous Control or ON/OFF Two-Point Control Manual Open Loop Control of Level, Flow, Pressure and Temperature Filtering of Measurement Signals from Sensors Offset and Re-ranging of Measurement Signals from Sensors Simulation with P&ID Model of Process Control without the Actual Hardware Testing and Commissioning of Process Control Hardware **Fault Simulation Module:** Four (4) Fault Simulation for Level Control Loop Six (6) Fault Simulation for Flow Control Loop Five (5) Fault Simulation for Pressure Control Loop Four (4) Fault Simulation for Temperature Control Loop Two (2) Fault Simulation for Pneumatic Systems Multiple Parametric or Software Fault Simulations with	
	Hand-outs (Book) Primary controller, Intel Core i5-2450M processor 3 MB L3	
	cache, 2.5 GHz with turbo boast up to 3.2/3.3 GHz, 4GB DDRIII, 500GB Training media including easy port, web-based training program, fundamentals of open and closed loop control	
90	**Advance Motor Control Workstation**	
	Automation Controller Workstation consist of the following: 1. Variable Frequency Drive 2. Push Buttons, Indicators, Analog Input, Analog Meter 3. Power Supply, compact Controller with integrated USB, Ethernet/IP Port and SD memory. Certified under Ethernet/IP 4. Digital I/O modules and analog output modules 5. Remote I/O Ethernet Adapter 6. Touch Screen Interface 6" 7. Primary controllers for wireless communications 8. With Control Software for multiple user.	
91	**Data Acquisition Device, NI myRIO University Bundle incl. Starter Kit and Mechatronics Kit (1 set: 10 units)**	
	With built-in LABView Software **Specifications:** (Typical between 0 to 40 degrees) Processor: type(Xilinx Z-7010), speed(667 MHz), cores(2) Memory: Nonvolatile memory(256 MB), DDR3 memory(512 MB), DDR3 clock frequency(533 MHz), DDR3 data bus width(16 bits), FPGA type:Xilinx Z-7010 Radio mode:IEEE 802.11 b,g,n, Frequency band:ISM 2.4 GHz, Channel width:20 MHz, Channels:USA 1-11, International 1-13, TX power: +10 dBm max (10 mW), Outdoor range : Up to 150 m (line of sight), Antenna directivity : Omnidirectional, Security:WPA, WPA2, WPA2-Enterprise, USB host port:USB 2.0 Hi-Speed, USB device port: USB 2.0 Hi-Speed	

ITEM	DESCRIPTION AND SPECIFICATION	
	Analog Input: Aggregate sample rate: 500 kS/s, Resolution: 12 bits, Overvoltage protection: ±16 V MXP connectors: Configuration: Four single-ended channels per connector Input impedance: >500 kΩ acquiring at 500 kS/s, 1 MΩ powered on and idle 4.7 kΩ powered off, Recommended source impedance:3 kΩ or less Nominal range : 0 V to +5 V, Absolute accuracy: ±50 mV Bandwidth:>300 kHz, MSP connector Configuration:Two differential channels Input impedance:Up to 100 nA leakage powered on; 4.7 kΩ powered off Nominal range: ±10 V, Working voltage, (signal + common mode):±10 V of AGND, Absolute accuracy: ±200 mV, Bandwidth: 20 kHz minimum, >50 kHz typical Audio input: Configuration:One stereo input consisting of two AC-coupled, single-ended channels, Input impedance :10 kΩ at DC ,Nominal range: ±2.5 V Bandwidth:2 Hz to >20 kHz Analog Output:	
	All AO channels on MXP connectors:345 kS/s	
	All AO channels on MSP connector and audio output channels:345 kS/s Resolution :12 bits, Overload protection:±16 V, Startup voltage:0 V after FPGA initialization MXP connectors Configuration:Two single-ended channels per connector Range:.0 V to +5 V, Absolute accurac:50 mV, Current drive:.3 mA Slew rate :0.3 V/µs MSP connector: Configuration:Two single-ended channels Range:.±10 V, Absolute accuracy:±200 mV, Current drive :2 mA Slew rate :2 V/µs Audio output: Configuration :One stereo output consisting of two AC-coupled, single-ended channels, Output impedance :100 Ω in series with 22 µF Bandwidth:70 Hz to >50 kHz into 32 Ω load; 2 Hz to >50 kHz into high-impedance load Power Output: +5 V power output, Output voltage :4.75 V to 5.25 V Maximum current on each connector: 100 mA +3.3 V power output: Output voltage: 3.0 V to 3.6 V Maximum current on each connector : 150 mA +15, power output: Output voltage:+15 V to +16 V, Maximum current :32 mA (16 mA during startup), -15 V power output: Output voltage:-15 V to -16 V Maximum current:32 mA (16 mA during startup) Maximum combined power from +15 V and -15 V power output :500 mW Power Requirements: NI myRIO-1900 requires a power supply connected to the power connector. Caution You must use either the power supply provided in the shipping kit, or another UL Listed ITE power supply marked LPS, with the NI myRIO-1900. Power supply voltage range:6-16 VDC, Maximum power consumption:14 W Typical idle power consumption:2.6 W Environmental: Ambient temperature near device (IEC 60068-2-1, IEC 600682-2):.0 to 40 °C Storage temperature: (IEC 60068-2-1, IEC 600682-2):.-20 to 70 °C Operating humidity (IEC 60068-2-56) :10 to 90% RH, noncondensing Storage humidity (IEC 60068-2-56) :10 to 90% RH, noncondensing Maximum altitude:2,000 m	
	Pollution Degree (IEC 60664) :2, Indoor use only.	
92	**Personal Computer with Complete Accessories, with UPS**	
	Core i3-3240/4GB/1TB/Windows 7 with 19.5-inch LED monitor or better	
93	**(Students' Chairs, Storage Cabinets & Multimedia Devices) 1 Lot**	
	Polypropylene Stacking Chair (45pcs) Chair seat & back: high-quality polypropylene, Chair frame: Round steel tube (heavy duty) , high quality electro-static powder coated	

ITEM	DESCRIPTION AND SPECIFICATION	
	Stacks 10 high from the floor Color: Navy blue/ dark blue **Storage Cabinet(2pcs)** 1.20m x 1.90m Sliding Glass doors on powder-coated aluminum frame with lock 18mm laminated boards with PVC edging **Storage Cabinet (1)** 1.20m x 1.90m Sliding Glass doors on powder-coated aluminum frame with lock 18mm laminated boards with PVC edging **Interactive Whiteboard (1)** 78" diagonal surface, 4 pens, 1wand, wall-mount, USB Interface computer connection, Workspace software; Infrared Technology-pen & finger touch with Windows, Mac or Linux; Multi-touch with Windows 7; aspect ratio; 4:3; 8000x8000 resolution; Android & IOS tablet compatible. **Multimedia Projector (1)** USB 3LCD Projector, 2800 (or better)Lumens White and Colour Light Output , Computer Cable, USB A/USB B Cables, Remote Control, Soft Carry Case & Manual	
	Civil Works (Program of Works, Detailed Cost Estimates, Drawings, etc.	
94	Laboratory Repairs Renovation (pls see details in approved EDP)	